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ABSTRACT

The purpose of this guide is to assist teachers in planning and organizing for the use of computers as part of their everyday mathematics curriculum. Mathematics was chosen as the subject area to demonstrate how students can be taught problem-solving skills and strategies with the computer. However, this computer integration guide provides background information, ideas, specific programs, and sample units that can help teachers from other school subject areas introduce and use computers in their classrooms. This guide includes: (1) planning for instruction, which considers specific methods to integrate the computer into the classroom, the relationships between problem solving and, respectively, the typical mathematics curriculum and specific classroom practices, and elements of effective lesson planning; (2) organizing for instruction, which discusses group strategies, the one-computer classroom, the computer lab, sample computer activities, desirable student interactions, classroom management tips, methods of monitoring student progress, and tools for creative students; (3) integrating problem solving, which investigates Polya's problem solving model, other specific problem solving strategies, and methods to integrate software units, specifically The Super Factory, Appleworks, and Microsoft Works; (4) curriculum software correlation, which juxtaposes specific pupil performance objectives of the Edmonton (Alberta, Canada) Public School Board with particular software routines from a plethora of manufacturers; and (5) appendices that contain software evaluation forms, classroom planning outlines, and classroom activity sheets. (JJK)

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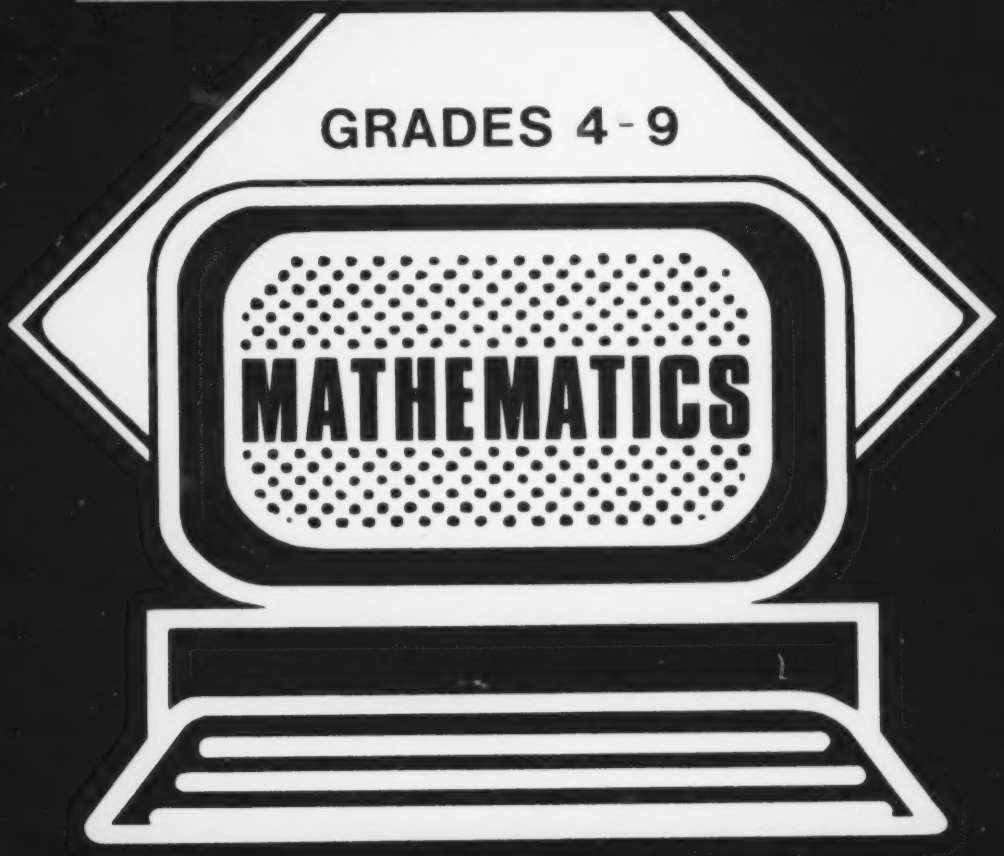
Computer Integration Guide:

GRADES 4-9



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Alberta
EDUCATION

Devonian Building, West Tower, 11160 Jasper Avenue, Edmonton, Alberta, Canada T5K 0L2

March 28, 1991

TO: Superintendents of Schools
Elementary and Junior High School Principals

Computer Integration Guide: Mathematics – Grades 4 to 9

Enclosed is a document entitled, "*Computer Integration Guide: Mathematics – Grades 4 to 9.*" Also enclosed are diskettes which contain files for the problems in either Appleworks or Microsoft Works (PC or Macintosh) formats.

It is my hope that documents such as this will assist your school and jurisdiction in the integration of the computer into curricular programs. The focus of this document is the use of the computer in problem solving and mathematics.

The ideas and applications in the guide are not meant as the final word on computer integration in this area. Rather, they can be used as a "launching vehicle" for teachers endeavouring to make the computer an integral component to student learning. I wish you and your teachers the best in this challenging task.

Please contact John Travers at 422-4872 if you wish any further information on the document. Also, additional copies of the guide and computer disks will be available from the Learning Resources Distributing Centre.

Sincerely,

Lloyd E. Symyrozum
Director of Curriculum

Enclosure

cc: Regional Office Directors

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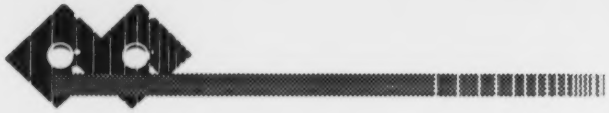

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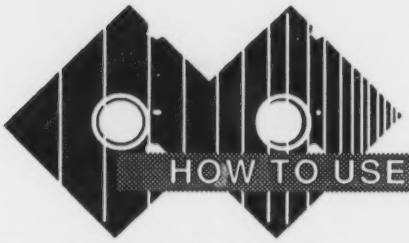


HOW TO USE THIS GUIDE

The purpose of this guide is to assist teachers in planning and organizing for the use of computers as part of their everyday curriculum. This computer integration guide provides background information, ideas, specific programs and sample units that will help teachers use computers in Division II and Division III mathematics classes.

We have chosen mathematics as a subject area to demonstrate how students can be taught problem-solving skills and strategies with the computer. If you teach in other subjects, the planning, organizing and problem-solving chapters can still be useful to you. We hope that it will serve as a model for you when incorporating computer technology into specific subjects.

Chapter 1 provides information on where computers can best be used in the curriculum and suggests some questions to consider in the process.

Chapter 2 deals with ways of arranging computers and students for classroom instruction. Tips on classroom management and using the computer to create activities for your students are also included.

If you have an extensive background in using computers in the classroom, you might wish to skip much of chapters 1 and 2.

Chapter 3 shows how computers may be used as problem-solving tools in the mathematics curriculum. The first part will show you how to integrate a single self-contained software program, *The Super Factory*, in the mathematics curriculum. The second part demonstrates, with specific examples, how to use the *AppleWorks* or *Microsoft Works* word processor, database and spreadsheet programs effectively in all stages of mathematical problem solving.

Chapter 4 lists software that matches the learner expectations/objectives for the 1982 Elementary (Division II) Program of Studies and the 1988 Junior High Program of Studies for mathematics.

Teachers are encouraged to use this guide as a practical planning and instructional tool for introducing computers into their mathematics classrooms. It is hoped that the problem-solving methods used in this guide will serve as models for other curricular areas.

Microcomputers were introduced into Alberta schools during the late 1970s, when individual teachers brought machines into their classrooms. As the price of hardware dropped and the pressure from the general public increased, schools began to spend a great deal of money on computer equipment. By the mid-1980s approximately 120,000 computers had been sold to schools in Canada. Within Alberta, a 1986 survey indicated that schools had purchased 22,751 computers. This represented a ratio of 20.3 students per computer.

During this period, much was said and written about the use of computers in education. At one extreme, there were those advocates who prophesied that computers were the single most important development in education since Gutenburg. At the other end of the continuum were those teachers who simply ignored and/or dismissed computers as yet another "technological fad."

Today, most educators take a middle view. However, while they believe that computer technology is extremely powerful and can contribute to many areas of education, they are often not sure how to start.

As a result, comments like the following can be heard in the staff rooms of many Alberta schools:

Yes. I have taken a few inservices on computers, but when I get back to the classroom I have so many other things to do I just don't have time to think about computers.

I use a few software programs with my students, but the software doesn't have much to do with what I'm teaching. There is really no instructional focus to their use.

I would use computers in my classroom but I have trouble locating good software.

Such comments indicate that even teachers who have a basic working knowledge of computers and are willing to use them in their classrooms are often not sure how to start to incorporate them into the curriculum. As a result, teachers often find themselves wedging computers into their classrooms in a somewhat artificial way. To integrate the computer into the curriculum effectively, there are a number of key decisions and issues that must be considered. This guide provides practical solutions and ideas to help teachers meet this challenge.

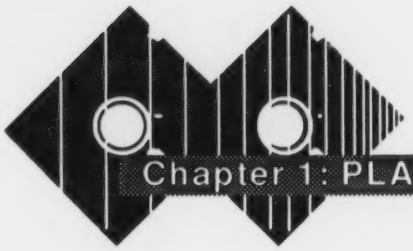
For nearly a decade, Alberta Education has formally encouraged the use of computers in schools by requiring that computers be used in certain courses, by helping to pay for hardware and software, by recommending software and by discussing computer use in teacher resource manuals.

Since the first computer was placed in an Alberta classroom, there has been a major shift in the way that computers are used in education. Originally, the emphasis was on teaching students about computers and how to program them. Now, schools are struggling to integrate the computer into general use in the classroom, in subjects such as mathematics, language arts, science, art, music and social studies.

Alberta Education's *A Strategic Plan for Microcomputers in Schools* (1987), gives direction to the development of this computer integration guide. The strategic planning document stressed that ...

> *The computer will have maximum effect if it is integrated into the curriculum in areas of identified need, and integrated with instruction through the provision of student and teacher support materials.*
>
> *The teacher must not only have the skills required to use the computing tool, but must at the same time be able to integrate this tool in the classroom to achieve the goals and learner expectations/objectives of the curriculum. This is the meaning of integration of the computer with instruction.*

This computer integration guide builds on previous Alberta Education initiatives by demonstrating how computers can be successfully integrated into the Division II and Division III mathematics curriculum.



Chapter 1: PLANNING FOR INSTRUCTION

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INTEGRATING THE COMPUTER

Planning for the integrated use of computers can begin in August or September, when you traditionally do your long-range curriculum planning for that year. This can be done easily by identifying strategic points in various subjects in which you think computers could enhance and improve your students' learning. However, without careful planning at the beginning of the year, you may find yourself either not using computers or using them in a haphazard fashion with little instructional focus.

As you know, computer integration will not happen overnight. At this early stage of computer use within our schools, it is unrealistic to assume that computers will be used extensively in all subject areas. It is very important that you start slowly and build your own computer competence by selecting only one or two pieces of high-quality software and becoming very familiar with them. Such an approach will not only help to convince you of the educational value of computers but it will also encourage you to expand the use of computers within your classroom the following year.

This document will lead you through the processes involved in planning for the integrated use of computers within the curriculum. First, the planning processes are discussed in general terms. Next, the document demonstrates how these planning processes are used to develop a series of computer-assisted teaching/learning activities in mathematics. If you teach mathematics, you may wish to use these activies in your classroom. If you teach other subjects, we recommend the math example as a model for developing your own lessons that incorporate computers into your subject areas.

How Can Computers Be Used in Education?

The instructional use of the computer can be divided into three areas: teaching and learning **about**, **with** and **through** computers. The following chart illustrates these areas:

Learning and Teaching . . .

. . . About

Computer Science

1. Programming
2. Theory

. . . With

Applications/Tools

1. Word processing
2. Databases
3. Spreadsheets
4. Graphics
5. Telecommunications
6. Specific application software

. . . Through

Computer-Assisted Instruction

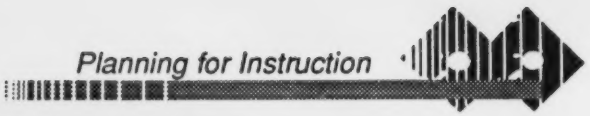
1. Drill and practice
2. Tutorials
3. Simulations and demonstrations
4. Problem solving

. . . Computers.

The following is a brief description of each instruction area:

1. Learning and teaching *about* computers
   This use of computers focuses on the discipline of computer science and includes computer engineering, data processing, information science, computer programming and the general theory of computers.

2. Learning and teaching *with* computers
   This use of computers focuses on the computer as a productivity tool: as an aid to problem solving or getting work done. This focus includes the use of general-purpose application packages (with database, graphics, spreadsheet, word processing and telecommunication modules) and application software specific to a particular discipline (e.g., music).



3. Learning and teaching *through* computers
   This use of the computer focusses on computer delivery of instruction. This focus has been called computer-assisted instruction, computer-based instruction and computer-assisted learning. Computer-assisted learning is sometimes divided into categories such as drill and practice, tutorials and simulations.

The last two categories may be of most interest to you, because it is within these areas that you would start to use the computer in any day-to-day learning activities you would develop for your students.

How Do You Integrate Computers into the Curriculum?

Jerrold Kemp, in his book entitled *Instructional Design*, states that...

> *"The goal of any educational program is to contribute to student growth by bringing about positive change in the student - in his attitudes, his ways of thinking, his knowledge, and his skills. This change must be brought about through the efforts of the learner himself as he learns. The teacher's teaching is only a means to this end. The main task of the teacher is to structure experiences that will lead to specified, desirable changes and then to motivate and stimulate the student to learn."**

In this view of education, you, as the teacher, become the facilitator of the learning process, deciding on and developing teaching/learning activities, procedures and materials to reach the desired learner expectations/objectives of the Alberta curriculum.

When designing learning activities that use the computer, the steps followed are very similar to those that teachers employ when using more traditional types of educational media in the classroom. However, because of the unique capabilities of the computer and the fact that most teachers have not had as much experience with using computers as they have had with other media, computer integration must be carefully planned and thought out.

To begin this planning process, ask yourself key questions in the following five areas: (1) Curriculum Analysis, (2) Computer Capabilities, (3a) Software Selection and Evaluation, (3b) Software Copyright, (3c) Software Licensing, (4) Software Use and (5) Student and Instructional Process Evaluation.

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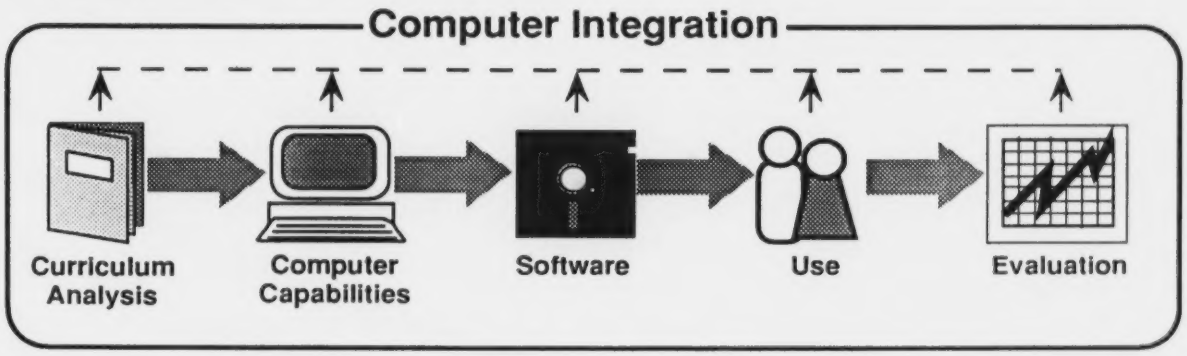
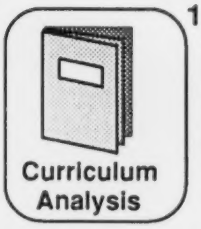
* Copied with permission from *Instructional Design* by Jerrold E. Kemp, D.S. Lake, Belmont, 1977.





1. Curriculum Analysis

The curriculum and your knowledge of it are the primary factors that determine where the computer will be used. The curriculum should be considered in relationship to learner expectations/objectives.

Questions to consider:

- What existing curriculum learner expectations/objectives can be met with the computer?
- Are there objectives that are too difficult to teach using other media?
- What factors do you know about your students that will affect your plans for their learning? (learning styles)
- What gaps in the instruction could be filled by computers?
- Where do your students continually have problems?
- What objectives do your students find more difficult to reach? (need more practice)
- Do some of your students require more remediation than others?
- Are enrichment opportunities available to your brighter students?
- Is normal instruction not safe?
- Is student motivation a problem?

2. Computer Capabilities

Next, you should look at the unique instructional capabilities of the computer itself. The computer is a powerful machine that can store, retrieve and manage large amounts of information quickly. Moreover, it has the power to simulate; it can allow your students to manipulate data and information easily; it can provide immediate feedback and graphic animation; it can motivate students.

Questions to consider:

- What can you do with the computer that you couldn't do before with other forms of educational media?

- Is the computer being used to accomplish learner expectations/ objectives that would be difficult to obtain as well by other means?
- Will the computer provide an interesting teaching/learning environment?

3a. Software Selection and Evaluation

The next step is to select and evaluate software to reach those curriculum objectives that you feel can be obtained through the use of the computer.

Software Selection

All software used in the classroom should be evaluated before use.

Questions to consider:

- What kind of software will be required? (application software, drill and practice, tutorials, simulations or problem-solving)
- Is there software available in the school or district to meet your objectives?
- Do the teacher resource manuals suggest any software programs?
- What kind of software has been evaluated and approved by Alberta Education?
- Are any software review guides available in the school or district to help with your selection?

Software Evaluation

Questions to consider:

- Does the software match the type of learner expectations/ objectives that you are trying to reach? (cognitive, psychomotor or affective)
- Does the software easily fit into the existing curriculum and your classroom structure?
- Does the software program allow for as much teacher control as possible?
- Is the software easy to use?
- Are screen displays clear and easy to read
- Is the software manual clear, concise and complete?

See Appendix A for a software evaluation form that may be used to evaluate your own software.

3b. Software Copyright*

As of November 1988, Canada's *Copyright Act* was amended by Bill C-60. In phase one of Bill C-60, computer programs are defined as "literary works" and consequently, all provisions applying to literary works under the act apply to computer programs.

The new act specifically states that the copyright owner of a computer program has the **exclusive** right to produce or reproduce the program in any material form whatsoever. When software is purchased, the purchaser owns the object containing the software program and can use the program the same way that a purchaser of a book can use a book. It is important to remember that ownership of copyright is not transferred to the purchaser, only the permitted use of the software.

The owner of an authorized copy of a computer program may make a single backup copy but the backup copy may not be legally used unless the authorized copy is destroyed or rendered inoperative. A backup copy therefore may not be used on a second computer station. In fact, the law states that the backup copy must be destroyed if the purchaser ceases to own the authorized copy of the program.

Copying a computer program includes loading the program into the memory of the computer at the initial booting up stage as well as copying the program onto another computer hard disk or floppy disk. Once the software has been copied into memory, a copy of the software has been made. Additional booting, including networking or multiple booting, constitutes copyright infringement. This means that unless otherwise stated in the licensing agreement for the software, one program disk is required for each computer. This is also true for programs that load completely into the computer memory and do not return to the disk drive.

---

* This information is copied from the *Junior High Computer Studies Teacher Resource Manual.* Alberta Education, 1990.

The *Copyright Act* provides for the following possible penalties for copyright infringement:

1. upon summary conviction, a person is liable to a fine of up to $25 thousand or imprisonment for a term of up to six months, or both

- or -

2. upon conviction or indictment, a person is liable to a fine of up to $1 million or imprisonment for up to five years, or both.

Software

3c. Software Licensing*

Licensing agreements often augment the minimum provisions outlined in the *Copyright Act* and stipulate the permitted use of the software with respect to the number of copies that can be made and the number of computers on which the software can be used. There are four licensing agreements that are of interest to schools and school districts.

1. District Licence: Upon payment of a fee, copies may be made or acquired for computer stations within the district. Usually the cost is determined by the number of computer stations within the district.

2. Site Licence: Allows a school to purchase a program and make as many copies of the program as needed for use in that school site by the teachers and students of that school. The cost of a site licence may be a standard amount or determined by the enrolment of the school.

3. Lab Licence, or lab pack: The software is licensed for use within a single classroom in a school.

4. Station Licence: The software is licensed for use on one computer station at a time.

Software developers/distributors often have differing policies in regard to licensing arrangements. You can often make your own special licensing arrangements by contacting the software company directly.

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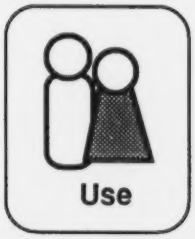
* This information is copied from the *Junior High Computer Studies Teacher Resource Manual.* Alberta Education, 1990.



4. Software Use

Having analysed the curriculum and decided which software program to use, your next step will be to develop a plan for its use.

Questions to consider:

- How much time will it take you to learn to use the program and integrate it into the curriculum? (Allow more than you think.)
- How do you plan to use the software?
- Will pre-computer activities have to be planned and organized?
- What prerequisite skills will your students need to use the software?
- What kind of lesson plan will best ensure that effective learning takes place?
- Does the software fit easily into the school schedule?
- How many different ways can the program be used with how many different students?
- How will you manage the use of the computer?
- Where is the best place to put the computers and how should they be arranged?
- How many of your students can participate at one time?
- How much time must each student be allocated?

5. Student and Instructional Process Evaluation

When planning for the integrated use of computers, you should build into that plan some type of an evaluation process. The purpose of this evaluation is twofold: first, to determine student achievement and second, to evaluate your instructional process.

Student Evaluation

For suggestions on evaluating the acquisition of mathematical skills, see Monitoring Students' Progress in Chapter 2.

Evaluating Problem-Solving Skills: Problem solving is a process. For this reason it is necessary to evaluate how successful your students are at all stages of the process.

The following Alberta Education monographs provide some excellent examples of evaluation models and forms for evaluating your students.

Let Problem Solving Be the Focus for the 1980s
(Elementary; 1983)

Problem Solving Challenge for Mathematics
(Junior High; 1985)

Problem Solving in Mathematics: Focus for the Future
(Senior High; 1987)

For more examples of evaluation strategies, consult:

Curriculum and Evaluation Standards for School Mathematics. National Council of Teachers of Mathematics. Reston, Virginia: National Council of Teachers of Mathematics, 1989.

How to Evaluate Progress in Problem Solving. Charles, R. et al. Reston, Virginia: National Council of Teachers of Mathematics, 1987.

(All of the above resources are available through the Learning Resources Distributing Centre.)

Instructional Process Evaluation

It is important that you evaluate your instructional process, particularly after first-time use of a given software program.

Questions to consider:

- Did the computer and the software program assist your students in reaching the curriculum learner expectations/objectives?
- How can you improve the learning activities and the use of the computer to ensure that better results can be obtained next time?
- Did the use of the computer take more or less time than traditional instruction?

Class discussions, individual interviews and observations of student behaviours can be used to evaluate your instructional process. The results can be recorded in your personal notebook.

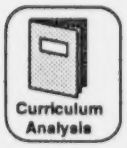
Remember, evaluation is not the end of the instructional process but rather the starting point for your next use of computers within your classroom.

Does This Integrated Computer Planning Process Really Work?

The preceding five-step computer integration model was used very successfully in the early planning stages of the mathematics problem-solving lessons developed for this document. The model provided us with a framework to generate key questions regarding the "where" and "how" of computer integration.

A blank copy of the computer integration form that we used is provided in Appendix B. This form will help you organize your own thoughts and plans about where and how computers could be integrated into your classroom.

Our completed Computer Integration Form for the mathematics problem-solving lessons for *The Super Factory* (pages 3-9 to 3-70) is also provided on page 1-14. This example illustrates some of our ideas for developing these lessons. Please read through it at this time.



First, we decided what subject area would most benefit from the use of computers. Mathematics was chosen for a number of obvious reasons, which are listed on our completed integration form, page 1-14.

Next, we selected and previewed a number of software programs, always keeping in mind the capabilities and limitations of the computer in relation to the curriculum learner expectations/ objectives.

Having decided which software program to use, we developed a plan for its use. At this stage, it is very important to remember that a software program, no matter how good it is, does not teach. It is the teacher who teaches; the software is only the medium. As a result, it was necessary for us to design student lessons and activities that would get the most educational value from the software program and meet the curriculum learner expectations/objectives. We had to become very familiar with the software program we intended to use. We not only had to learn the "mechanics" of the program but also understand its learning expectations/objectives. Based on our knowledge of the software program, we developed pre-computer activities, lessons on the mechanics of the program and problem-solving activities for students.

Lastly, we designed a plan to determine students' levels of achievement and to evaluate the instructional process.

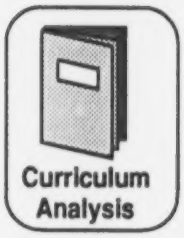
How Will the Mathematics Problem-Solving Lessons Be of Benefit to Me?

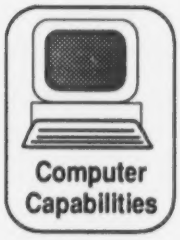
If you currently teach mathematics, the following lessons will be invaluable to you. The lessons will clearly demonstrate that the use of computers within the mathematics curriculum is not an "add on" but a valuable tool that can enhance your students' learning. In particular, these lessons can be used to replace the more traditional approaches to problem solving that you may be using with your students. You will soon discover that computers can provide a stimulating environment, which can result in improved student motivation and learning. Moreover, the lessons illustrate an integrated approach to mathematics that combines paper and pencil, manipulatives and computer technology as the student moves from concrete to abstract reasoning.

The first part of this guide will show you how to integrate a single self-contained software program in the mathematics curriculum. The second part demonstrates how to use the *AppleWorks or Microsoft Works* word processing, database and spreadsheet programs effectively in all stages of mathematical problem solving.

If you are not a mathematics teacher, the problem-solving lessons will provide you with a number of ideas and techniques for computer integration. In addition, the lessons can serve as a model for you in the development of your own lessons, which would incorporate the use of computers into your specific subject area(s).

COMPUTER INTEGRATION FORM





1. Curriculum Analysis

Elementary/Junior/Senior High Mathematics

- Teacher Resource Manuals (Curriculum guides)
- problem solving is a major goal of the math curriculum
- teaching problem-solving skills and strategies is very important - but at times difficult to do
- some teachers are unaware of different strategies and how they can be effectively taught
- there is a need to develop positive student attitudes - enjoy math - motivation
- curriculum is placing more emphasis on the use of computers in math

2. Computer Capabilities

Important Features:

- graphics and animation
- immediate feedback
- test solutions
- allows students to work with data and information

3. Software Selection and Evaluation

- need to select and evaluate problem solving on simulation software
- available at school or district
- check Alberta Education for authorized software
  "The Super Factory"
- documentation very good but lessons need rewriting
- easily fits into the math curriculum
- has a lot of program controls

4. Software Use

- I will need to learn "The Super Factory"
  - A. Mechanics of program
  - B. Learner expectations/objectives of program
- I will need to develop a plan for the program's use
  - A. Pre-computer activities
  - B. Teach mechanics of program to students
  - C. Develop learning activities to teach problem-solving strategies (the program <u>will not</u> teach the strategies; I will do that in relation to the program)

5. Student and Instruction Process Evaluation

- I will need to develop an evaluation plan for:
  - A. Student achievement
  - B. Instructional process

PROBLEM SOLVING, COMPUTERS AND THE MATHEMATICS CURRICULUM

Problem solving is a major goal of the math curriculum at all grade levels. The Junior High Mathematics Teacher Resource Manual (1988) specifies that ...

> *The most important goal of mathematics instruction is the development of a student's ability to solve problems. The emphasis on problem solving requires a change in focus from exclusively finding answers to routine word problems to the acquisition and application of many different skills and strategies.*

In addition, the manual states that ...

> *Technologies such as computers and calculators must be used to develop concepts, to explore relationships, to explore patterns, to organize and display data and to eliminate tedious computations.*

The Alberta Education monographs listed on page 1-11 of this guide may be valuable to you in your efforts to assist your students in further development of problem-solving skills.

PROBLEM-SOLVING RESEARCH AND CLASSROOM PRACTICES

Because problem solving is a major goal of the math curriculum, you should be aware of some research findings that have implications for the educational use of computers. Marilyn Suydam summarized problem-solving research during the 1980s with nine problem-solving research statements:*

1. Teaching students a range of strategies increases their options when attacking problems. If one way doesn't work, they know other ways that might.

2. Systematic instruction based on a problem-solving model enhances students' success. Instruction on specific strategies may be particularly beneficial.

3. Diagramming, writing original problems and listing help the problem-solving process, possibly by stimulating visual images, imagination and memory.

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* This nine-point summary is reproduced with permission from *Teaching and Learning: A Problem-Solving Focus.* Frances R. Curcio, ed. Reston, Virginia: National Council of Teachers of Mathematics, 1987.

4. Discussion of the nature of the problem, the strategies used and the reasons for using them may be vital to the successful teaching of problem solving. Knowing not just "what to do" but "why to do it" promotes transfer to new problems.

5. What you teach about problem solving does have an effect. If problem solving is treated as "apply the procedure," then the students try to follow the rules in subsequent problems. If you teach problem solving as an approach, where you must think and can apply anything that works, then students are likely to be less rigid.

6. The operational or developmental level of students affects what they do and how well they learn and apply problem-solving strategies.

7. It not only is possible but also seems necessary to show explicitly how to translate the written words of a problem into a mathematical statement.

8. Calculators can enhance students' problem-solving achievement and certainly widen the choice of problem-solving strategies.

9. Working in small groups to solve problems can be an effective way not only to practise cooperation but also to improve problem-solving skills.

LESSON PLANNING

Lesson planning, whether it is done formally or informally, is a key element of any successful lesson. This is especially true when using a computer or computers as part of a lesson.

Teacher preparation includes arranging for classroom use of computers and software. Software related activities not using the computer may be necessary before, during and after computer use (especially if computers are not available for each student).

The following page contains a sample format for planning a lesson. It includes introductory, development and culminating suggestions. Carefully planned lessons using computers can be used to vary the activities that will develop mathematics in meaningful and creative ways for your students. (A blank lesson planning form is provided for your use in Appendix C.)

ELEMENTS OF EFFECTIVE LESSON PLANNING

Grade/Level:

Strand:

Learner Expectation:
(Objective)

Clarification of Expectation/Description
A brief description of the lesson activity and clarification of the learner expectation.

Teaching Tips
Suggestions for teachers in presentations of this topic. Ideas for display, sources of information, etc.

Teacher Preparation
Suggestions that will enhance the lesson (e.g., presentation suggestions, displays, handouts or grouping strategies for students).

Student Preparation
Identify prerequisite knowledge/skills students should have for this lesson.

Resources
Specific reference to basic or support resources for this lesson to include software, hardware and print references with page numbers.

Suggested Activities
Activities should be student centred for the most part, in keeping with the approach of the program, but may also be teacher centred. They should be detailed and reflect good lesson presentation strategies (e.g., effective teaching strategies set, active participation, closure). Include masters of sample handouts or assignment sheets where applicable. Suggest a timeline for completion.

Evaluation
Identify evaluation strategies with sample instruments where applicable.

Elective Suggestions
Alternative suggestions for remediation or enrichment in this lesson.

Post-Lesson Comments
List suggestions for the next time this lesson is used.

Chapter 2: ORGANIZING FOR INSTRUCTION

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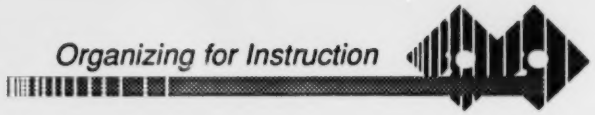

GROUPING STRATEGIES*

Grouping in this context does not imply a physical arrangement of students; it is merely an administrative tool to provide for many activities to be carried on in one classroom at any one time. Often students will be interacting with others in their "group," but just as often they will be working on the same topic, independently of members of their "group."

Instructional material may be presented to students in a variety of ways. It is recommended that no one delivery method be used throughout the course. Following are a number of possible grouping strategies that teachers may find helpful:

Traditional Lecture Format

This teaching technique need not be discarded, and may be most effective when presenting curriculum content appropriate for all students. The obvious advantages are efficient use of time and the sense of cohesiveness that students achieve in this instructional setting.

Small Group

The students may be placed into small groups according to different criteria at different times.

Grouping strategies that you might find useful are:

• Heterogeneous

This grouping method provides the opportunity for two or three different problems to be carried out at the same time at different "stations."

• Ability

Grouping students of similar ability facilitates parallel development in a certain area. This way no group is "held back" or "pushed" through the learning of a specific topic or module.

OR

Grouping students of different abilities allows the more advanced student to serve as motivator and peer tutor for the group, and gives the student with fewer skills more "personalized" attention. This also helps students gain the social skills necessary to collaborate effectively with others.

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* This information is adapted from the *Junior High Computer Studies Teacher Resource Manual.* Alberta Education, 1990.

• Need
Grouping students with similar needs provides opportunities for remedial or enrichment work in a specific area.

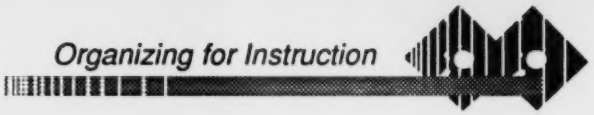
• Interest
Grouping students with shared interests enhances the motivation that is so critical to learning.

• Achievement
Grouping students according to their level of expertise in a given area of study allows them to develop new skills together.

Remember, within any of these grouping strategies, students within the group may or may not communicate and assist each other — your teaching style dictates the activities in the classroom.

One-to-One
In certain situations, it may be more appropriate for students to be instructed on a one-to-one basis. The distinct disadvantage for student/teacher grouping in this manner is that it decreases instructional time for others, and it tends to impede classroom management. However, there are situations where this grouping can be used to advantage. In addition, student/student grouping in a peer-tutoring situation can be used very successfully.

Individual Study
Some class situations might lend themselves to independent study. This can be facilitated through a worksheet approach or an individualized library research project, or simply through a "read and report" assignment on various topics.



Cooperative Learning*

Cooperative learning is a learning concept receiving more and more attention each year. The essence of cooperative learning is to place students into groups in which everyone is responsible for the learning of each person in the group. The achievement of each individual then becomes a cooperative effort. It is not necessary to use the entire process in every class; rather, it is a package from which teachers may choose according to the needs of their classes.

Different teachers use a variety of methods in setting up groups depending on the ages of the students, the concepts being taught and the available resources. There should be the same cross-section of individual achievement within each group. Every group should include a complete range of student achievement from high achievers through to average and low-achieving students.

The group may not seek assistance from the teacher unless everyone in the group has a hand up seeking help for the same question. If someone in the group knows the solution to the group's problem, it is the responsibility of that person to teach the rest of the group. This approach is based on the idea that learning is enhanced when we prepare to teach someone else.

Not all the teaching is done on a cooperative basis; it is merely another tool in the teaching/learning process. If the teacher is interested in developing basic concepts, these may be taught to the entire class. The application and use of the basic concepts can be handled better in a cooperative learning situation.

Peer Teaching*

Students who are successful problem solvers can be asked to present their solutions to other students. This not only enhances the development of the presenter's communication skills but also reinforces the processes used to find a solution. For the students who are being taught, peer teaching demonstrates that a problem's solution is attainable and provides them with instruction that may be more easily understood than that given by a teacher. Furthermore, this technique helps instil confidence in students about their ability to solve problems, and creates an awareness of other ways to solve or think about problems for students who may also have attained a solution.

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* This information is adapted from *Problem Solving in Mathematics: Focus for the Future.* Alberta Education, 1987.

THE ONE-COMPUTER CLASSROOM*

Should microcomputers be placed in classrooms or labs? The debate about the best location for microcomputers in the school has no right answer. Ideally, schools should have a computer lab AND computers in each classroom. At the junior high level, most computer activities would be facilitated by a lab setting. However, under certain conditions a single computer may be appropriate.

The challenge for the teacher in the one-computer classroom is to make the best use of this exciting educational tool. Begin by realizing that there are some things that cannot be done in this setting and stop feeling guilty about it. The computer can, however, be effective as a teacher demonstration tool.

Teacher Demonstration Tool

There are several ways to set up a computer so that the whole class can view the screen. Every school should have at least one of these systems available for teachers to share among classrooms.

1. Large screen television: A computer can be connected to a standard or large screen television through the composite video port. An RF-modulator, available for less than $10 from Radio Shack, may be required for older TV models. Text smaller than 40 columns cannot be seen because of the grainy resolution of the television screen.

2. Chained monitors: One computer can send images to several monitors at once, if extras are available. RCA stereo splitter cables, available from Radio Shack for a few dollars each, split the signal, sending it from monitor to monitor in the chain. (Purchase single male to dual female cables.) Colour and brightness are lost as more monitors are added to the chain.

3. Overhead palette or projection system: An overhead palette projects a computer image using a standard overhead projector. Text in 80 columns is clear. Monochrome models sell for $800 or less and are compatible with most types of computers.

A. Computer-Enhanced Lessons: The computer is similar to the chalkboard, the overhead projector and the felt pen and chart paper. The computer is used as a visual aid for teaching a lesson to the whole class or to a group of students.

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* This information is adapted with permission from the *Computers and the Junior High Mathematics Curriculum.* Edmonton Public Schools, 1990.

Software for computer-enhanced lessons (examples)

any word processor, database or spreadsheet
Easy Graph II, Grolier
Problem-Solving Strategies, MECC
Geometric Supposer Series, Sunburst
Conquering Math Series, MECC
Geometric Concepts, Perimeter and Area, Jostens

Presentation software for creating your own lessons

Slide Shop, Scholastic
Showoff, Broderbund (GS only)
VCR Companion, Broderbund

B. Cooperative Learning Groups: The computer is similar to the gameboard and to the simulation game. The computer manages an educational game in which groups compete against each other. Each member of the group assumes a different role so that cooperation within the group is essential. Computer games that ask how many players there will be can often be used with cooperative learning groups.

Software for cooperative learning groups (examples)

The Factory
Sell Lemonade, The Market Place, MECC
Oregon Trail
MECC programs

Student Learning Centre

The computer station is usually placed in a corner of the classroom near an electrical outlet. It should be arranged so that the teacher can easily monitor student activities at the centre and so that the rest of the class will not be distracted by discussion, sound effects or screen displays. There should be enough room for two or three students at the centre at once.

When planning a computer learning centre ask yourself these questions:

1. What learner expectations/objectives do I have? Are these learner expectations/objectives for a group of students? for individuals? or for the whole class?
2. Will the centre activities reinforce? remediate? enrich?
3. What software will I use? How will students learn to use it – teacher demonstration? peer tutor? on their own?
4. How many students will work at the centre at one time?
5. How much time per visit will I allocate – 20 minutes? until they are finished?

6. How much time is available for centre time? How much is down time (e.g. phys. ed., command performance)?
7. Will one visit be enough for students to complete the activity or will they require a series of visits?
8. Will students have a choice of activities or will I make the decision about what they will do in the centre?
9. What related off-computer activities will I use before and after students attend the computer centre?
10. Is the computer centre activity as motivating and appealing as activities that will be occurring in the rest of the classroom?
11. How will I ensure that students will be able to work independently at the centre so that I can work with the rest of the class?
12. How will I keep track of who has used the centre and whose turn it is now?

Individualizing instruction in the computer centre

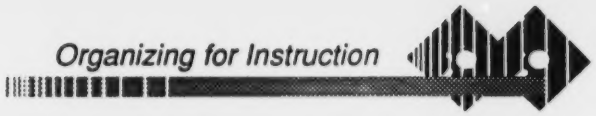
Educational software is usually designed with some degree of teacher control. Many of the MECC disks, for example, have a hidden teacher management section where student scores can be viewed and changes to the playing level of the programs made. (<Control>-A pressed at the main menu will enter the teacher options in MECC software.) The centre can include several copies of one disk, each set to a different playing level. Colour-coded dots on the disk labels remind the teacher of the setting.

Software programs that provide "templates" allow teachers to create their own work lists or questions. Although it takes time to enter the words and questions, it is worth the effort because the activity at the computer centre will be tailor-made to the needs of the class. Separate data disks can be used to store the questions, which can be revised each year by the teacher as desired.

Select or design open-ended activities so that students can participate at different levels and can incorporate their own interests. Give some degree of choice to students but do not let the centre degenerate into a computer games station. For example, as software is introduced throughout the year, add it to a box or display area and occasionally let students choose whatever they want to use from this selection.

Empowering students

Help students to become independent in the computer centre. Displays should include reminders about operating the hardware and software. Everyone should know how to boot a disk and how to turn the system off for the day. Students should know where disks are stored and should assist in keeping the centre tidy. (Include a "sick disk" box, too.)



Every student should have a personal user's manual into which they write reminders about commonly used software. A file folder with paper stapled inside works well. Include the steps in booting a disk.

A trouble light made by gluing a red paper cup to a green one, base to base, sits on the computer monitor. When students at the computer centre need assistance, they turn the cup over so that the red one is up. When it is convenient, the teacher or a student expert comes to the centre to assist.

Every student should have the opportunity some time during the school year to be a class expert for the computer centre. The teacher can train a small cadre of peer tutors to use a program and have them teach the others. Often "experts" will emerge naturally; nurture this phenomenon but try to spread the expertise around.

Minimizing distractions from sound effects

Sound effects can usually be turned off in software. MECC disks, for example, provide this option on the main menu. If you are already using the program, <control>-S or <apple>-S will usually toggle the sound off and on.

The Apple IIgs provides two more ways to control distracting sounds. The control panel lets you adjust volume and pitch (enter the control panel by holding down three keys: apple, control, escape), or a standard set of headphones can be plugged into the headphone jack on the back panel of the Apple IIgs.

USING A COMPUTER LAB*

What is a computer lab?

Computer labs vary in size and location but they have one thing in common. A lab is located somewhere in the school but not in **your** classroom. Because the lab is removed from the minute-by-minute events in your classroom, you must plan carefully so that lab activities are related to ongoing themes and teachable moments.

Hardware in a computer lab

The single computer system is the building block of the computer lab. In elementary and junior high schools, an Apple IIe with monochrome monitor and single 5.25" disk drive is the most common configuration.

An overhead projection system connected to a computer should be available in the lab for teacher demonstrations to the whole class. Otherwise, one computer should be connected to a television set on a high stand (this is adequate for displays of 40 columns or larger).

Use of computer lab

The amount of time in a computer lab setting varies with the type of activity. If students are using software that drills basic facts and algorithms, 20 to 30 minutes is optimum. If, however, they are engaged in problem-solving activities, the time can be extended to 45 minutes or more.

Activities should be designed to encourage discussion and sharing among students. Off-computer activities related to the software should be used whenever possible.

There's more than one way to use a lab of computers!

Activities conducted in a lab can be categorized as low-order use and high-order use, depending on the degree of complexity in organizing and managing the classroom. The chart on the following page summarizes, in rank order, six ways in which activities can be carried out in a computer lab. You may want to add your own ideas to the chart.

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* This information is adapted with permission from *Computers and the Junior High Mathematics Curriculum.* Edmonton Public Schools, 1990.

I. ORGANIZATION CHART*

This chart is not meant to represent a progression of phases through which you will pass as you learn to use computers with students. All of the activities in the chart are good ways to use a lab; the type of activity you choose will depend on the educational goals you have set and the learning styles of your students. Your lessons in the computer lab should be varied in nature just as you vary the way you teach in a regular classroom.

High-order use (increased complexity in classroom organization and management).

Different Software at Computers

INDEPENDENT ACTIVITIES
Students use different software at each station, selecting the appropriate tool to complete the task; e.g. productivity tools.

MULTI-ACTIVITY THEME
Pairs or groups of students rotate through centres (of single or clusters of computers) in which software and off-computer activities all relate to a common theme; e.g. MECC programs, Geometric Concepts, Conquering Math series.

INDIVIDUALIZED INSTRUCTION
Individual or small groups of students use software set to an appropriate level or selected to meet their unique needs; e.g. MECC drill.

Same Software at all Computers

COOPERATIVE LEARNING GROUPS
Groups of two to four students work at each computer on a task to be completed cooperatively. The same software is used by all groups; e.g. simulations, educational games, database activities.

OPEN-ENDED ACTIVITIES
All students use the same software to participate in open-ended tasks that can meet a broad range of needs and interests; e.g. Logo, Geometric Supposers.

SKILL DEVELOPMENT
All students participate in the same large group lesson with the same or similar hands-on activities; e.g. learning operational skills, introduction to productivity tools or new software.

Low-order use (decreased complexity in classroom organization and management).

* This information is adapted with permission from *Computers and the Junior High Mathematics Curriculum.* Edmonton Public Schools, 1990.

SAMPLE COMPUTER ACTIVITIES*

A. ONE VISIT to the computer centre or lab.

1. Play a mathematics game, such as:
   - MAC Series, grades 6-8, Houghton Mifflin
   - Number Munchers, MECC
   - Fraction Munchers, MECC
   - Other MECC software

2. Use a word processor to:
   - Write student-generated math problems
   - Create vocabulary lists
   - Make a table of commonly used math rules or equations
   - Make student notes

3. Use a database to:
   - Record data collected from a survey
   - Sort data from a survey

4. Use a spreadsheet to:
   - Design a calculator for several formulas
   - Create a metric conversion table
   - Solve math problems

5. Use teacher resource "generator" software to:
   - Create crossword or crossnumber puzzles
   - Create signs, banners and definitions for class

B. A SERIES OF VISITS to the computer centre or lab.

1. Use drill and practice software to master basic skills
   - Conquering Math Series, MECC
   - Math Sequences, Milliken
   - Other MECC programs

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* This information is adapted with permission from *Computers and the Junior High Mathematics Curriculum*. Edmonton Public Schools, 1990.

2. Use problem-solving software, such as:
   - Gears, Sunburst
   - King's Rule, WINGS for learning
   - Number Quest, Sunburst
   - Power Drill, Sunburst
   - Problem-Solving Strategies, MECC

3. Work on an enrichment project:
   - Whatsit Corporation (The), Sunburst
   - Royal Rules, Wings for learning
   - Create, record and sort survey data on database
   - Spreadsheet to design own "formula solver"
   - Compose a research document using word processor

4. Play mathematical games for motivation:
   - Have class contest with a mathematical computer game
   - Use Motion Geometry: Floppy Math, Nelson
   - Use other MECC programs

STUDENT INTERACTIONS*

It is a myth that working on a computer is a solitary experience. In most classrooms, it is a socializing agent. The following student interactions can be orchestrated by the teacher.

1. One student at the computer is appropriate for tasks of a personal nature: drill of basic facts, a personal Logo project and enrichment project.

2. Two students at the computer cooperating to solve problems enter into meaningful discussions about mathematics.

3. Two students at the computer competing against each other to answer questions or play a mathematics game.

4. Two students taking turns at the computer is appropriate at all ages. By watching a peer, some students gain confidence in their own abilities. By sharing with another, positive social behaviors are reinforced.

5. Two pairs of students competing in a mathematical game. Of course, cooperation is occurring within each pair.

Do not rely on one type of grouping when using computers with students. By varying the types of interactions during "computer time," motivation can be maintained.

Change the students within the pairs regularly to allow different people to play a dominant role.

The "expert syndrome" will occur naturally. One or two students within the class will become known by their peers as the resident experts. Whenever a computer question arises, these experts will be called upon for advice. Do not discourage this phenomenon as it makes the class more independent of the teacher and enhances the self-esteem of the "expert." You may want to point out the expertise of other students in the class, too.

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* This information is adapted with permission from *Computers and the Junior High Mathematics Curriculum.* Edmonton Public Schools, 1990.

CLASSROOM MANAGEMENT TIPS*

1. Make students independent of the teacher by:
   a. Pairing students so that they can troubleshoot together.
   b. Naming a class "expert" who can assist with problems at the computer centre. Spread it around; everyone in the class should be an expert on something.
   c. Posting colourful reminders in the centre.
   d. Teaching students some steps to try:
      - Check your typing
      - Check the reminders or your book
      - Ask a friend or a class expert
      - Lastly, ask the teacher
   e. Placing a trouble light at each computer. (Glue two papers cups together, base to base; one red, one green.) When the green cup is up, everything is fine. When the red cup is up, the teacher will assist as soon as possible.
   f. Organizing a system of peer tutors in which each student is responsible for teaching two others. This is especially effective between older and younger students.

2. Maintain an acceptable sound level by:
   a. Turning the sound off on disks, if necessary. For example, Control-S will turn the sound off on most MECC disks. Volume can be lowered on the Apple IIGS by using the control panel.
   b. Learning to distinguish "noise" from "sound." Pairs of students discussing mathematical problems at the computer may sound noisy at first.
   c. Letting students become actively involved in deciding what is acceptable. Adopt a soundless signal, such as dimming the lights, to alert the class to the need to bring the sound level down.

3. Keep classroom materials organized by:
   a. Adopting a storage system for diskettes and teaching the students how to use it. Do not leave the classroom until everything is in its proper place.
   b. Colour coding disk labels to match the box, binder or pocket chart into which it is stored.
   c. Setting up a box of disks for each small group of students with similar needs or for individual students with special needs.

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* This information is adapted with permission from *Computers and the Junior High Mathematics Curriculum*. Edmonton Public Schools, 1990.

4. Enlist the help of volunteers or teacher aides by:
   a. Providing hands-on training in the basics (computer skills and mathematical concepts).
   b. Making the educational decisions yourself. A volunteer or teacher aide should not choose software for students but can assist them in using it.

MONITORING STUDENTS' PROGRESS*

It is important to monitor progress at the computer to ensure that each student is experiencing success and to plan for the next steps in the instructional process.

1. Teacher observations should focus on the ways in which students interact with the computer software and with each other. Observations can be recorded as anecdotal notes or on a checklist. Some things to watch for include:

   Are they participating enthusiastically?
   Are they focused on the task?
   Are they experiencing success?
   Are they trying different strategies rather than sticking to only one method?
   Are they discussing the problem together?
   Can they solve problems independently or with assistance?
   How often do they choose to use paper and pencil instead of the computer?

2. Some disks record students' scores automatically. The teacher should look at these scores regularly, especially when students have been working independently at the computer centre. Students experiencing difficulty may need reteaching in a different medium before returning to the computer activity.

3. Students can keep a written record of their progress at the computer centre. This may include scores and comments such as "Today I learned ___ at the computer centre."

Students' records should not be posted on wall charts. Success is making progress toward a personal goal, NOT filling the cells in a wall chart the fastest. Students will be working on different disks and at different levels within the same disk.

4. Traditional assessment techniques, such as quizzes and tests, should be used to monitor the acquisition of mathematical skills.

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* This information is adapted with permission from *Computers and the Junior High Mathematics Curriculum*. Edmonton Public Schools, 1990.

5. Teachers may want to participate in some action research to determine whether or not the way in which they have used computers with students is effective. Some questions to study:
   - Do students learn their basic facts more quickly when the computer is used for regular drill?
   - Are students more enthusiastic about practising basic facts and operations on the computer than with more traditional materials such as textbooks, workbooks and worksheets?
   - Is the computer a motivating medium for all students?
   - Do some students benefit more than others by using the computer in mathematics?

COMPUTER TOOLS FOR MATHEMATICS TEACHERS*

Several types of computer applications can save time for a busy teacher and provide the teacher with tools to create activities specifically for students.

1. Test bank programs

a. By choosing from pre-programmed objectives, tests or worksheets are generated for individuals, small groups or the entire class. The teacher chooses the learner expectations/objectives to be tested and the number of questions in software such as MECC's Mastering Math Worksheet Generator.

b. Teachers can create their own collection of questions and use them in any combination with test-bank software such as MECC's Study Guide.

2. Puzzle generation

Software such as Crossword Magic or MECC's Puzzles and Posters can be used in mathematics as well as language arts. Vocabulary or mathematical expressions can be entered and the computer will generate a crossword or word search puzzle, complete with answer key.

3. Displays

Print Shop is a popular program for making posters and banners. The Print Shop Companion also creates calendars, an important tool for a mathematics classroom.

Timeliner creates banner-like timelines with information entered by the teacher or student.

4. Graphing tools

The teacher can create activity sheets and displays using graphing tools such as Easy Graph and MECC Graph.

5. Certificates of achievement

Certificate Maker is an example of a program that prints certificates according to the wishes of the user. It includes several borders and certificate styles. All you have to do is name the award and add the name of the student, school and teacher.

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* This information is adapted with permission from *Computers and the Junior High Mathematics Curriculum.* Edmonton Public Schools, 1990.

6. Record keeping and reporting

Software can assist the teacher in recording student scores on tests, quizzes and assignments. Averages are calculated and student reports printed out.

7. Notes to parents; classroom newsletters

Word processors are all-purpose tools that replace the typewriter. MECC's Labels, Letters and Lists is an easy-to-use set of tools for creating personalized notes to parents.

Chapter 3: INTEGRATING PROBLEM SOLVING

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Problem-Solving Strategies	**3-6**
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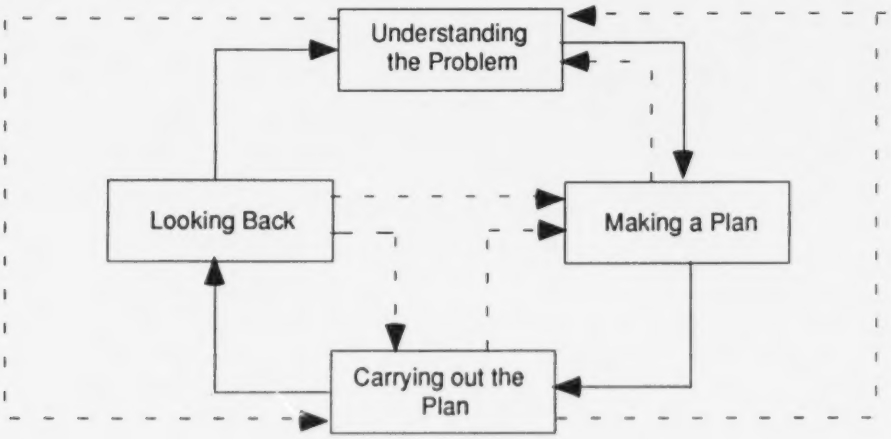
Integrating by Using Application Software (*AppleWorks and Microsoft Works*)	**3-71**

POLYA'S PROBLEM-SOLVING MODEL*

In 1945, George Polya published *How To Solve It* in which he outlined a four-step model which could be used during the solution of problems.

Problem solvers can learn individual skills and stategies which can be used within this framework and as they broaden their knowledge their facility for solving problems will improve.

Polya's framework is not fixed. Although problem solvers may approach a solution in the order outlined, they will often return to earlier stages because they have encountered an obstacle or because it becomes obvious that another approach will work better.



Understanding the Problem

In this stage of the model, the problem solver should begin to think about the problem and attempt to clarify what is given and what is being asked. In order to understand the problem, the solver may have to:

- read the problem several times
- refer to other resources to clarify the meaning of key words and phrases
- restate the problem using familiar terms

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* This information is adapted from *Problem Solving in Mathematics: Focus for the Future.* Alberta Education, 1987.

- evaluate the data in the problem to determine whether there is sufficient information to solve the problem and whether any of he data is extraneous
- determine if there are hidden assumptions that contain information necessary to the solution of the problem
- diagram, simulate or model the problem situation
- consider alternative interpretations.

Making a Plan

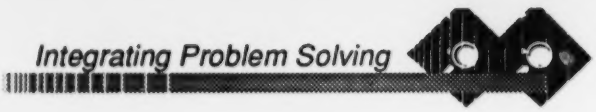
Once a problem is understood, a plan for solution should be developed. Since problems may be solved in a variety of ways, a problem solver should give thought to the different strategies that may be employed and try to choose the one (or the combination) which seems most appropriate. However, a good problem solver should be prepared to revise a plan if an initial strategy proves unworkable.

Some of the **strategies** that may be employed in solving problems are to

- work backwards
- simulate, model or diagram the situations in the problem
- use organized lists, charts, tables or graphs
- look for a pattern
- select appropriate notation
- identify given, needed and wanted information
- use a formula or write an equation
- solve a simpler, related problem
- partition a problem and solve each part
- use logical deduction
- check for hidden assumptions
- guess an answer, test it and adjust the guess
- change the point of view.

Carrying Out the Plan

After a plan has been developed, the next stage is to implement the planned strategy and attempt to solve the problem. In carrying out the plan, it is essential that problem solvers continually monitor their progress in order to determine whether or not their plan will lead to a solution. The solver may, in fact, find that the plan will not produce a solution, in which case a new plan will have to be developed.



In monitoring progress toward a solution to a problem, the solver should ask

- Is my plan leading toward a solution?
- Do I need to alter my a plan, or perhaps abandon it for a new one?
- Do I need additional information or assistance in carrying out my plan?
- Am I carefully documenting my efforts in order to keep track of my progress

Looking Back

After the plan has been worked through and the solution has been achieved, the problem solver should look back and reflect on the process. It is important that the solution answers what the problem originally asked and that it makes sense within the context of the problem.

The looking back stage is a time to extend what has been accomplished. In this stage, the problem solver should internalize the successful strategies and processes for future use as well as look for different approaches to a solution. A good problem solver will extend the problem beyond its stated parameters; perhaps to answer unasked questions, generalize a solution or examine a related situation.

The problem should be well documented so that its solution will be clear to others and the problem solver should be able to communicate and defend both processes and results.

A problem solver should answer the following questions during the looking back phase:

- Is my answer reasonable?
- What have I learned that I didn't know before?
- What are the features of this problem that I will recognize in other problems?
- Can I make and solve related problems?
- Can I explain, document or generalize the solution?
- Have I found all of the solutions?
- Have I tried strategies other than the one which first gave me the solution?

PROBLEM-SOLVING STRATEGIES*

There are a number of problem-solving strategies that can be taught using the math problems that have been included in this guide. However, the main ones that can easily be used are: Guess and Check, Using Manipulatives or Acting Out the Problem, Making an Organized List, Working Backwards, and Looking for a Pattern.

Guess and Check

Guess and Check is a very important problem-solving strategy that is often overlooked by both teachers and students. When the student uses this strategy he or she first guesses the answer, tests to see if it is correct and makes another guess if the previous one was incorrect. In this way, these students gradually come closer and closer to a solution by building upon past information and by making more reasonable guesses. Students often can use this strategy to get started and may then find another strategy that can be used.

Using Manipulatives or Acting Out the Problem

Some students may find it helpful to act out a problem or to move objects around while they are trying to solve the problem. It allows them to develop visual images of both the data in the problem and the solution process. By taking an active role in finding the solution, students are more likely to remember the processes they used and to be able to use them again for solving similar problems.

Making an Organized List

Making an organized list helps problem solvers organize their thinking about a problem. Recording work in an organized list makes it easy to review what has been done and to identify important steps that must yet be completed. It also provides a systematic way of recording computations made with given data or recording combinations of given items.

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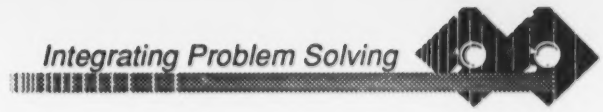
* This information is adapted with permission from *The Problem Solver 4: Activities for Learning Problem-Solving Strategies*. Judy Goodnow and Shirley Hoogeboom, Creative Publications, 1987.



Working Backwards

To solve certain problems, the student must make a series of computations, starting with data presented at the end of the problem and ending with data presented at the beginning of the problem.

Looking for a Pattern

A pattern is a regular, systematic repetition. A pattern may be numerical, visual or behavioural. By identifying the pattern, the student can predict what will "come next" and what will happen again and again in the same way.

Other strategies or heuristics such as: *Diagrams, Logical Reasoning, Assuming a Solution, Simplifying and Breaking the Problem into Smaller Pieces* can also be used to come to solve problems. More difficult situations may require using combinations of the above strategies.

INTEGRATING THROUGH AN INTEGRATED UNIT

THE SUPER FACTORY

Teaching Strategies for Using *The Super Factory*	**3-10**
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Part B – Research and Design	**3-21**
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Teaching Strategies for Using *The Super Factory*

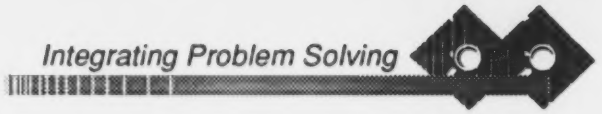
The section on *The Super Factory* that follows may be used in several ways:

1. Parts A (Pre-Computer Activities), B (Research and Design) and C (Math Problems) may be used together as a complete integrated unit.

2. Parts A and B may be used to introduce the properties of a cube using manipulatives; then, using *The Super Factory*, students review and experiement with designing cubes using these properties.

3. Use only the problem-solving section (Part C) as part of your problem-solving exercises.

You may wish to modify or use only part of the exercises presented to suit your own requirements.



PART A
Pre-Computer Activities

Pre-Computer Activities
Lesson 1

Learner Expectation
Students will understand the properties of a cube and the effects of rotations and flips (90°, 180°, 270° and 360°) upon symmetrical pictures placed on the faces of a cube.

Teaching Tips

In presenting the lesson to students, review the concepts of symmetry, rotations and flips (upward and downward rotations of the cube).

All pictures that are symmetrical with respect to both the X and Y axes are also **rotationally symmetrical**. In other words, if we place a square upon a cube face and the cube is rotated and flipped, the square will retain its original shape and the direction will seem to remain the same.

Any picture that has direction and is not symmetrical with respect to both the X and Y axes will sometimes be **rotationally asymmetrical** with respect to certain combinations of rotations and flips.

On all cutout cube sheets, the front of the cube is designated by markings in the four corners. These markings are similar to those found on the cube in *The Super Factory*.

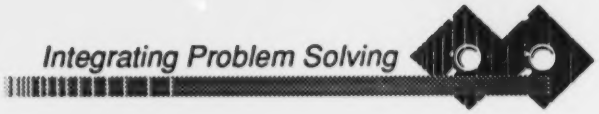
In addition, the cutout cube sheets are similar to the cutout cube sheet found on page 30 of Ginn's *Journeys in Math 7 -Teaching Aids* booklet and Holt's *Math 7 Resource Centre, Resource Master 17*.

Encourage your students to work in pairs.

Suggested Activities

1. Using **Cutout Cube Sheet 1** (page 3-15), students cut out and assemble the cube by either gluing or taping the edges. (A master copy is found in Appendix D.)

QUESTIONS
- How many faces does the cube have?
- What can you say about each face?



2. Students place the cube on their desks with the SQUARE (front of cube) facing them.
   The picture of the PLUS-SIGN is on the top face of the cube.

3. Students rotate the cube to the right (counterclockwise) 90°.

QUESTIONS
- What did you observe?
- Where are the pictures?
- Are the pictures symmetrical (retain their original shape)?

4. Students rotate the cube to the right another 90° (180° in total).
   The CIRCLE should be facing the students and the PLUS-SIGN should be on the top face of the cube.

QUESTIONS
- What did you observe?
- Has the PLUS-SIGN remained symmetrical?
- Has the CIRCLE remained symmetrical?
- Where is the other picture?

5. Students rotate the cube to the right another 90° (270° in total).
   A blank face should be facing the students and the PLUS-SIGN should be on the top face of the cube.

QUESTIONS
- What did you observe?
- Has the PLUS-SIGN remained symmetrical?
- Where are the other pictures?

6. Students rotate the cube another 90° to the right (360° in total).
   The front face of the cube with the picture of the SQUARE on it should be facing the students and the PLUS-SIGN is on the top face of the cube.

QUESTIONS
- What did you observe?
- How many degrees have you rotated the cube?
- How many turns have you rotated the cube?
- What would you observe if you rotated the cube the same number of degrees clockwise?
- Do the figures remain symmetrical after each rotation?

7. Students flip the cube 90° downward.
   The PLUS-SIGN should face the students and the CIRCLE should be on the top.

QUESTIONS
- What did you observe?
- Where are the other pictures?
- Have the CIRCLE and the PLUS-SIGN remained symmetrical?

8. Students flip the cube 90° downward again (180° in total).
   The CIRCLE should be facing the students and a BLANK FACE should be on top.

QUESTIONS
- What did you observe?
- Where are the other pictures?
- Have the pictures remained symmetrical?

9. Students flip the cube 90° downward (270° in total).
   A BLANK FACE faces the students and the picture of the SQUARE is on top.

QUESTIONS
- What did you observe?
- Where are the other pictures?
- Has the picture of the SQUARE remained symmetrical?

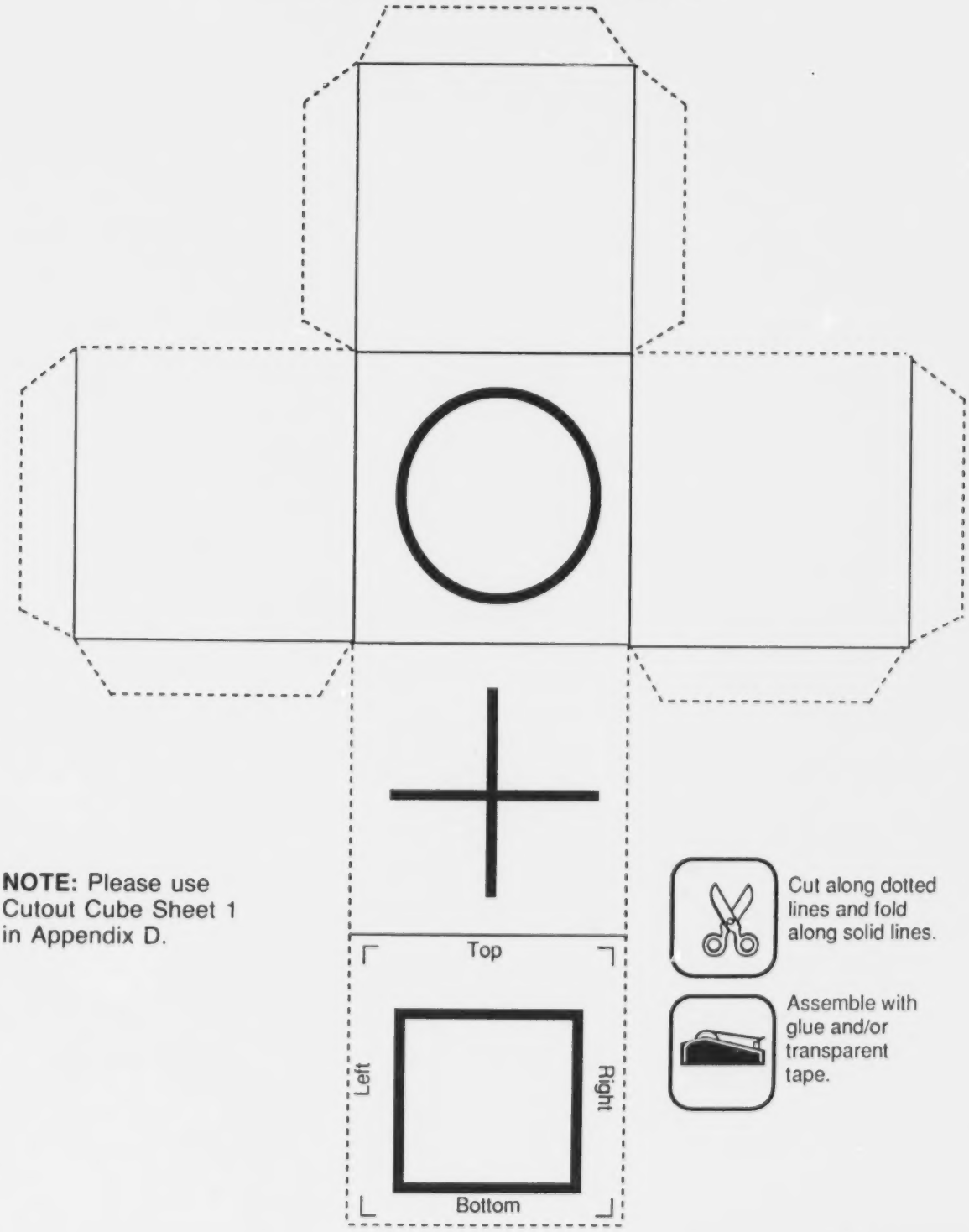
10. Students flip the cube 90° downward (360° in total).
    Front face with the SQUARE is facing the students and the PLUS-SIGN is on top.

QUESTIONS
- What did you observe?
- Where are the other pictures?
- Have they remained symmetrical?

11. Students flip the cube downward 180° and then rotate the cube 180° right (counter-clockwise).
    The SQUARE should be facing the students and a BLANK FACE should be on the top. However, notice that the face of the cube has become reversed: the top is the bottom and the bottom is the top. Also, the left and right are reversed: the left now becomes the right and the right becomes the left. However, the picture of the SQUARE remains the same; hence we may say that the SQUARE is symmetrical with respect to rotating and flipping the cube.

QUESTIONS
- What did you observe?
- Where are the other pictures?
- Have they remained symmetrical?

Cutout Cube Sheet 1



NOTE: Please use Cutout Cube Sheet 1 in Appendix D.

Cut along dotted lines and fold along solid lines.

Assemble with glue and/or transparent tape.

Pre-Computer Activities
Lesson 2

Learner Expectation
Students will understand the effects of rotations and flips (90°, 180°, 270° and 360°) upon asymmetrical pictures placed on the faces of a cube.

Teaching Tips

Review the concepts of symmetry, rotations and flips from Lesson 1.

Any picture that has direction and is not symmetrical with respect to both the X and Y axes will sometimes be **rotationally asymmetrical** with respect to certain combination of rotations and flips. For example, when a picture, such as a capital **A**, is placed upon a cube face and the cube is rotated and flipped, that particular **A** will retain its original shape but its direction will change. (The **A** will either be on its side or upside down.) The **A** is therefore considered rotationally asymmetrical with respect to the rotation and flip.

Encourage students to work in pairs.

Suggested Activities

1. Using **Cutout Cube Sheet 2** (page 3-19) students cut out and assemble the cube by either gluing or taping the edges. (A master copy is found in Appendix E.)

2. Students place the cube on their desks with the **A** facing them.
   The PLUS-SIGN is on top.

3. Students rotate the cube to the right (counter-clockwise) 90°.
   The PLUS-SIGN is on top and it has remained symmetrical. The A is on the right side and it has retained its original shape; therefore it is still considered rotationally symmetrical. However, the ARROW, which is located on the left side of the cube, does not coincide with the original ARROW because it has changed direction. Therefore, the ARROW is asymmetrical with respect to a 90° rotation.

QUESTIONS
- What did you observe?
- Where are the pictures?
- Have they remained symmetrical?

4. Students rotate the cube to the right another 90° (180° in total).
   The PLUS-SIGN is on top and it has remained symmetrical. The A is on the back of the cube and it remains symmetrical. However, the ARROW, which is now facing the students, is pointing in the opposite direction from the original. Therefore, the ARROW is asymmetrical with respect to the 180° rotation.

QUESTIONS
- What did you observe?
- Where are the pictures?
- Have they remained symmetrical?

5. Students rotate the cube to the right another 90° (270° in total).
   The BLANK FACE of the cube faces the students. The PLUS-SIGN remains on the top face of the cube and it has retained its original shape. The A is on the left side of the cube and it remains symmetrical in relation to the rotation. However, the ARROW has changed direction and is, therefore, asymmetrical with respect to the 270° rotation.

QUESTIONS
- What did you observe?
- Where are the pictures?
- Have they remained symmetrical?

6. Students rotate the cube another 90° to the right (360° in total).
   The front face of the cube with the picture of an A on it should be facing the students, and the PLUS-SIGN is on the top. The ARROW is on the back face of the cube pointing in its original direction.

QUESTIONS
- What did you observe?
- How many degrees have we rotated the cube?
- How many turns have we rotated the cube?
- What would you observe if you rotated the cube the same number of degrees clockwise?
- Do the pictures remain symmetrical after each rotation?

7. Students flip the cube 90° downward.
   The PLUS-SIGN should face the students and the ARROW should be on top. Both the PLUS-SIGN and the ARROW remain symmetrical in that they coincide with the original direction. However, the A is now asymmetrical in relation to the flip.

QUESTIONS
- What did you observe?
- Where are the other pictures?
- Have they remained symmetrical or are they asymmetrical?

8. Students flip the cube 90° downward again (180° in total).
   The ARROW should be facing the students and the SQUARE is on top. The SQUARE and ARROW remain symmetrical with respect to the 180° flip. The A is asymmetrical.

QUESTIONS
- What did you observe?
- Where are the pictures?
- Have they remained symmetrical?

9. Students flip the cube 90° downward (270° in total).
   The SQUARE faces the students and the A is on top.

QUESTIONS
- What did you observe
- Where are the pictures?
- Have they remained symmetrical?

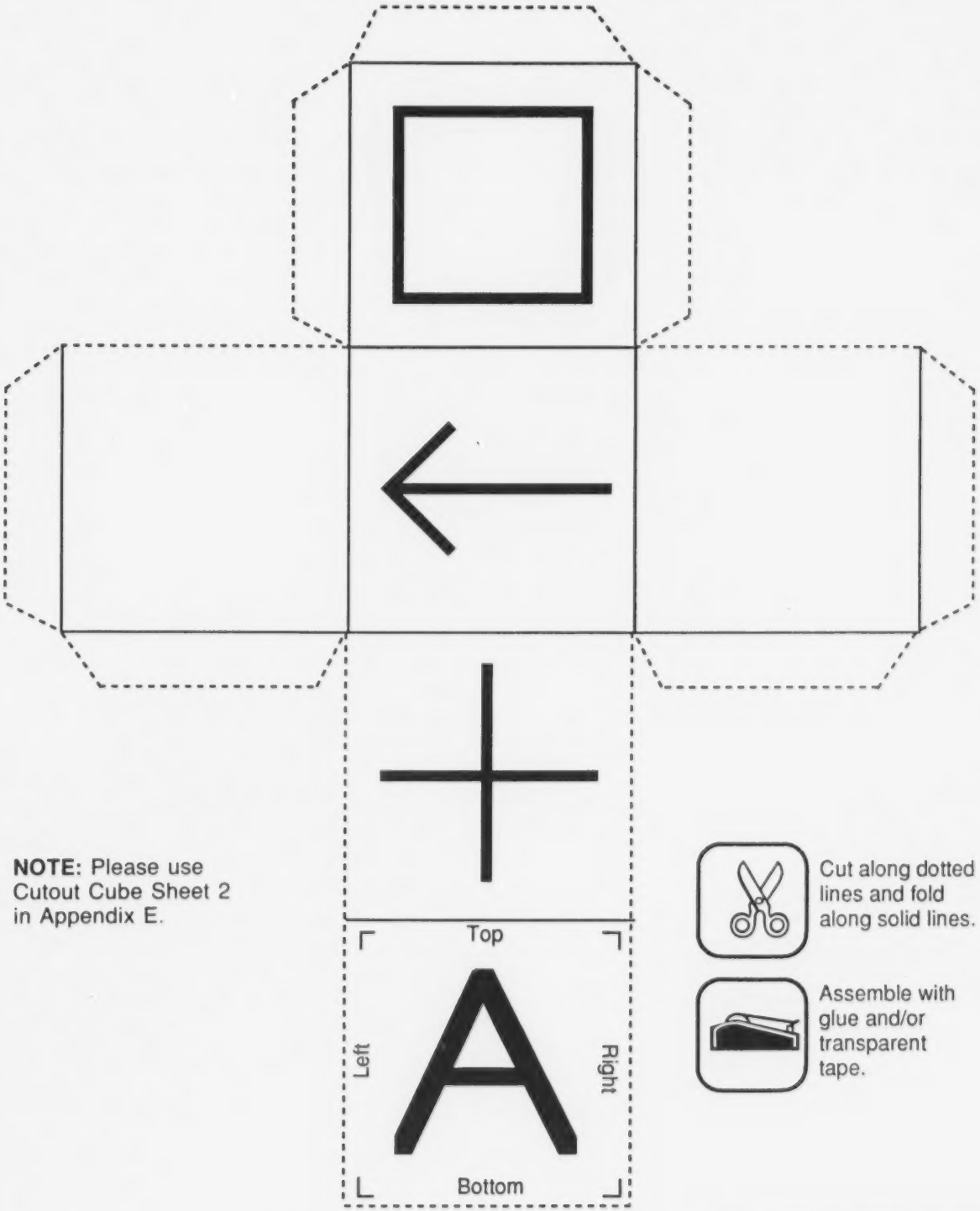
10. Students flip the cube 90° downward (360° in total).
    The front face of the cube with the A on it is facing the students and the PLUS-SIGN is on top. All pictures are back to their original locations. Therefore, they are all symmetrical with respect to the 360° flip.

QUESTIONS
- What did you observe?
- Where are the pictures?
- Have they remained symmetrical?

11. Students flip the cube downward 180° and then rotate the cube 180° right (counter-clockwise)
    The SQUARE is on top and the A is upside down, facing the students. Students should notice that the face of the cube has become reversed. The A is asymmetrical and the SQUARE is symmetrical in relation to the 180° flip and 180° rotation.

QUESTIONS
- What did you observe?
- Where are the other pictures?
- Have they remained symmetrical?

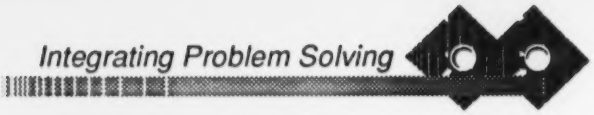
Cutout Cube Sheet 2



NOTE: Please use Cutout Cube Sheet 2 in Appendix E.

Cut along dotted lines and fold along solid lines.

Assemble with glue and/or transparent tape.



PART B
Research and Design

Mechanics: Research
Lesson 3

Learner Expectation
To review the design of a cube and introduce students to the mechanics of the RESEARCH section of the software program, *The Super Factory*.

Teaching Tips

In the RESEARCH section of the program, students design a cube by placing pictures on the cube faces. Initially, a blank cube will appear. The front face is recognized by the marks on the four corners of the blank cube.

There are six pictures at the bottom of the screen that may be placed on the faces of the cube. Also, by pressing P an additional 18 pictures are made available for selection.

At any time, the main menu may be accessed by pressing the CONTROL key and E together.

From the main menu you can access the CHANGE OPTION menu by pressing the CONTROL key and T together. This menu will allow you to turn off the sound or change the picture options.

The Apple IIe computer keyboard is the one referred to throughout these lessons. If you are using an Apple II+, use the I, J, K, and L keys in place of the Apple IIe arrow keys.

Demonstrate the RESEARCH section of *The Super Factory* using a large monitor and computer prior to having students work with the program on their computers.

Suggested Activities

1. Boot the program, *The Super Factory*.

2. The main menu appears. Using the UP and DOWN arrow keys, move the location box around the term RESEARCH. Press RETURN.

3. INTRODUCTION TO THE MECHANICS
   a. Press the APPLE key with the RIGHT arrow key four times to rotate the cube to the right a total of 360° (counter-clockwise).
   The front of the cube should be visible after the rotation.

   b. Repeat using the APPLE key with the LEFT arrow key to rotate the cube 360° clockwise.

c. Press the APPLE key with the DOWN arrow key four times to flip the cube downward.
The front of the cube should be visible after the flips.

d. Repeat using the APPLE key with the UP arrow key to flip the cube upward four times.
The front of the cube should be visible after the flips.

4. SELECTION OF PICTURES
a. Highlight the LIGHT BULB using the RIGHT or LEFT arrow keys and then press RETURN.
The LIGHT BULB appears on the front face of the cube.

b. Rotate the cube 180° to the right by pressing the APPLE key and the RIGHT arrow key twice.

c. Use the RIGHT arrow key to highlight the picture of the KEY. Press RETURN to select.
The design of the KEY is positioned on the face of the cube.

d. Rotate the cube another 180° to the right by pressing the APPLE key and the RIGHT arrow key twice.
The front of the cube with the LIGHT BULB should be visible.

QUESTIONS
- What is on the back face of the cube?
- What does it look like?
- If the cube is flipped down twice, what will the key look like? (Since the KEY is asymmetrical it is upside down.)

e. Flip the cube upward twice.
The FRONT of the cube should be visible.

5. SELECT A THIRD PICTURE
a. Flip the cube DOWN once using the APPLE key with the DOWN arrow key.

b. Use the RIGHT or LEFT arrow keys to highlight the SWAN. Press RETURN.
The SWAN appears on the face of the cube.

c. Flip the cube upward using the APPLE key and the UP arrow key.
The front of the cube is now visible.

QUESTIONS
- What pictures are on the cube and what are their respective locations?
- How can you bring the SWAN to the front?(Bring the SWAN to the front.)
- Where is the KEY?
- How can you bring the KEY to the front?
- What would it look like?(Bring the KEY to the front.)
- Where are the LIGHT BULB and the SWAN?
- How would you bring the LIGHT BULB to the front?

- What would it look like?
- If you rotate the cube 180° to the right, what picture will appear? (Bring the LIGHT BULB to its original position.)

6. ACCESSING DIFFERENT PICTURES
   a. Use the RIGHT arrow key to highlight QUIT.

   b. For the prompt DO YOU WANT TO DESIGN ANOTHER CUBE? choose YES. Press RETURN.

   c. Press P to access the additional pictures.

   d. Use the arrow keys to position the box around the picture of a SQUARE. Press RETURN. Now move the highlighting to the picture to be replaced (the UMBRELLA) and press RETURN.
   The UMBRELLA at the bottom of the screen should be replaced with the picture of the SQUARE.

   e. Use the arrow keys to position the box around the picture of a CIRCLE. Press RETURN. Now move the highlighting to the picture to be replaced: the SNAIL. Press RETURN.
   The SNAIL at the bottom of the screen should be replaced with the picture of the CIRCLE.

   f. Use the arrow keys to position the box around the picture of a PLUS SIGN. Press RETURN. Now move the highlighting to the picture to be replaced: the SWAN. Press RETURN.
   The SWAN at the bottom of the screen should be replaced with the PLUS SIGN.

   g. Highlight DONE. Press RETURN.

7. DESIGN A CUBE WITH THE NEW PICTURES
   a. Place the LIGHT BULB on the front face of the cube.

   b. Rotate the cube 180° to the right and place the PLUS-SIGN on the face.

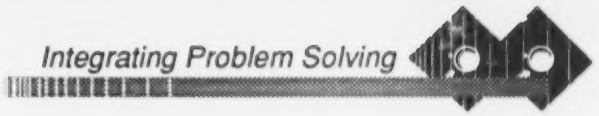
   c. Rotate the cube another 90° to the right and place the SQUARE on it.

   d. Rotate the cube once more to the right, a 90° turn.

QUESTIONS
- What pictures are on the cube?
- Where are the pictures and what do they look like?

   e. Flip the cube downward once and place the ICE CREAM CONE on it.

   f. Rotate the cube to the right, making a 90° turn, and place a KEY on it.



g. Rotate the cube so the front of the cube is visible.
The LIGHT BULB is now visible.

QUESTIONS
- What pictures are on the cube and what are their locations?

h. Verify by rotating and flipping the cube.

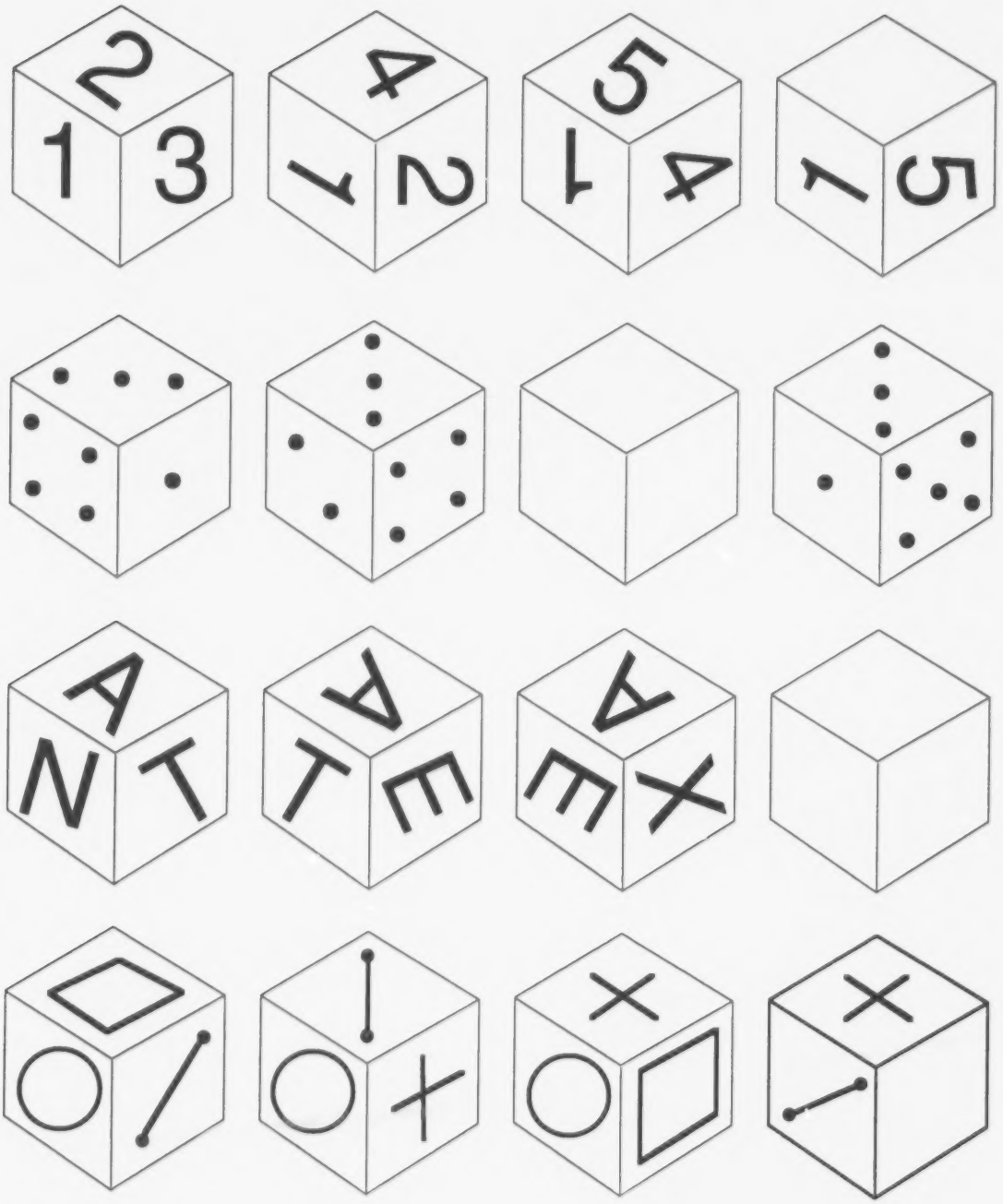
8. Students do **Activity Sheet 1** (page 3-26) in pairs. Students look at each set of cubes and determine how the cube has been rotated or flipped. Students then place the correct pictures on the blank faces. (A master copy of the activity sheet is in Appendix F.)

9. Students do **Activity Sheet 2** (page 3-27) in pairs. In this activity, students design a cube and develop a sequence of rotations and flips. They then challenge another group of students to solve the last cube of the sequence. (A master copy of the activity sheet is in Appendix G.)

- Students place pictures on the faces of the first cube in row A.
- They then decide whether to rotate or flip that cube.
- Pictures are then placed on the second cube of row A based upon that rotation or flip.
- The same procedure is followed for the third cube in row A.
- The last cube is left blank.
- Have the students exchange **Activity Sheet 2** with another pair of students. They then try to determine what the pictures would be on the last cube.
- Repeat procedure for each row.

Activity Sheet 1*

Draw the correct pictures in the sequence



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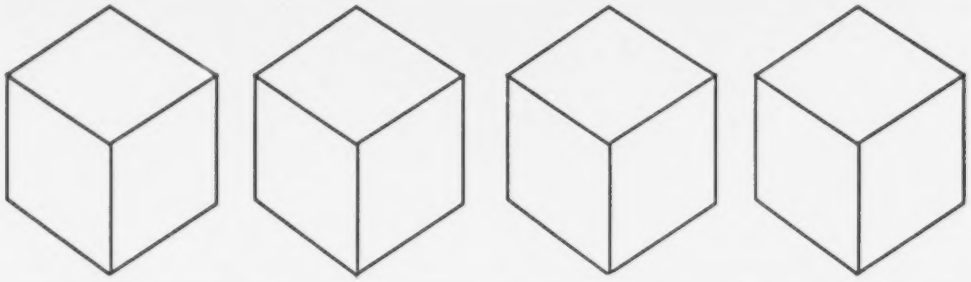
Activity Sheet 2

A



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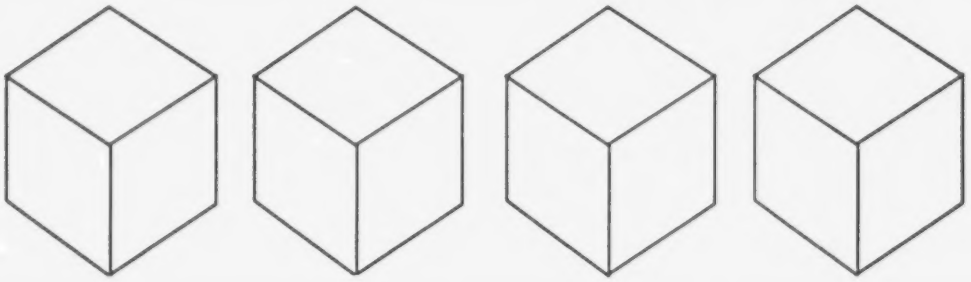

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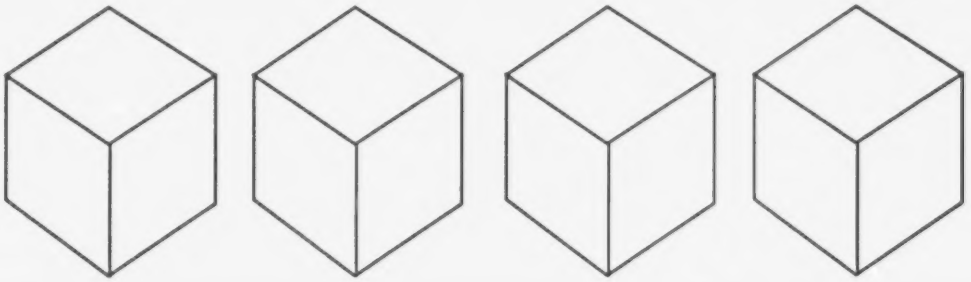

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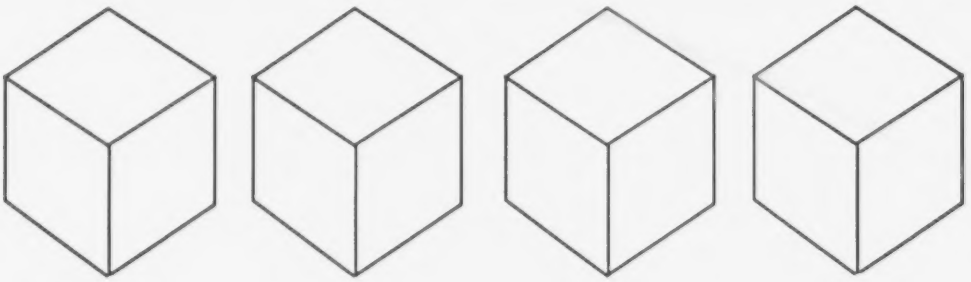


Mechanics: Design
Lesson 4

Learner Expectation
To introduce students to the mechanics of the DESIGN section of the software program, *The Super Factory*.

Teaching Tips

Demonstrate the DESIGN feature of *The Super Factory* using a computer and large monitor in front of the entire class before allowing students to use the program.

The DESIGN feature allows the student to construct a plan in the design of a cube. The student affixes his or her name to the design. In the upper right corner of the design the number of steps in the construction of the cube is noted.

There is a SAVE feature for the designs. If you do not want students to save their designs at this point, you may go back to the main menu by pressing the CONTROL key and E together. Next, the CHANGE OPTION menu is accessed by pressing the CONTROL key and T together. From this menu you can turn off the SAVE feature of the program.

Suggested Activities

1. DESIGN A CUBE
   a. Boot the program, *The Super Factory*.

   b. The main menu appears. Move the location box around the term DESIGN, using the UP and DOWN arrow keys. Press RETURN.

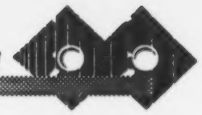
   c. Type in your name and press RETURN.

   d. Use the arrow keys to position the box around the term PICTURE. Press RETURN.

   e. Highlight the LIGHT BULB by using the arrow keys. Press RETURN.

   f. Use the arrow keys to position the box around the term TURN. Press RETURN.

   g. Highlight the RIGHT arrow key by using the arrow keys on the keyboard. Press RETURN.



h. Use the arrow keys to position the box around the term PICTURE. Press RETURN.

i. Highlight the SNAIL by using the arrow keys. Press RETURN.

j. Use the arrow keys to position the box around the term TURN. Press RETURN.

k. Highlight the RIGHT arrow key by using the arrow keys on the keyboard. Press RETURN.

l. Use the arrow keys to position the box around the term PICTURE. Press RETURN.

m. Highlight the UMBRELLA by using the arrow keys. Press RETURN.

n. Use the arrow keys to position the box around the term TURN. Press RETURN.

o. Highlight the DOWN arrow key by using the arrow keys on the keyboard. Press RETURN.

p. Use the arrow keys to position the box around the term PICTURE. Press RETURN.

q. Highlight the ICE CREAM CONE. Press RETURN.

2. TRY THE DESIGN

a. Use the arrow keys to position the box around TRY. Press RETURN. Each step in the design is executed.

b. Use the arrow keys to position the box around STEP. Press RETURN. Keep pressing RETURN to go through each design step-by-step.
The ICE CREAM CONE is on the top of the cube. To place the ICE CREAM CONE on the bottom of the cube we have to EDIT our plan.

3. EDIT THE PLAN

a. Use the arrow keys to position the box around the term PLAN. Press RETURN.

b. Use the arrow keys to position the box around the term EDIT. Press RETURN.

c. Position the box around the term DELETE. Press RETURN.

d. Position the brackets around the DOWN arrow. Press RETURN.
The DOWN arrow key is deleted.

e. Position the box around the term INSERT. Press RETURN.

f. Position the brackets around the ICE CREAM CONE. Press RETURN.

g. Position the box around the term TURN. Press RETURN.

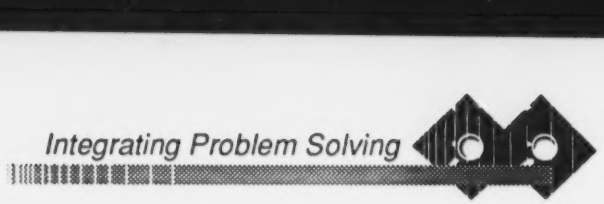
h. Highlight the UP arrow key. Press RETURN.

i. Position the box around the term DONE. Press RETURN.

j. Position the box around the term TRY. Press RETURN.

4. Student Activity

Have students work in pairs or in small groups to experiment with the DESIGN section of the program.



PART C
Introduction
Math Problems

Grade Level
Divisions II and III

Strand
Geometry and Problem Solving - Divisions II and III

Learner Expectation
Demonstrate effect use of *The Super Factory* in all stages of mathematical problem solving

Clarification of Expectation/Description
The Super Factory deals with spatial geometry. It allows students to place pictures upon the faces of a cube and to rotate and examine the cube.

The Super Factory consists of three levels

1. The Research level allows students to experiment with a cube and become familiar with the mechanics of the program.
2. The Design section lets students build cubes at a more advanced level.
3. In the Challenge section, which ranges from Easy to Difficult, students must build a duplicate of the challenge cube.

Six problems have been developed to illustrate how *The Super Factory* can be integrated into Division II and Division III mathematics courses using Polya's problem-solving model.

Table 1 lists *The Super Factory* problems contained within this guide for both elementary and junior high students. Also indicated are the various problem-solving strategies which can be used with each problem.

Section 1 problems (pages 3-37 to 3-57) include questions to help the students work through each problem. In addition, each problem has teacher notes and a teacher answer guide. The math problems listed in Section 2 (pages 3-59 to 3-62) contain the problem and a blank student master of Polya's model.

Elementary and Junior High Mathematics

Problem Solving

"THE SUPER FACTORY" Problems

	STRATEGIES			
	Use Manipulatives or Act Out the Problem	Make an Organized List	Looking for a Pattern	Working Backwards
Section 1				
Problem 1				
Problem 2				
Problem 3				
Section 2				
Problem 4				
Problem 5				
Problem 6				

Table 1

Teacher Preparation

It is important that you have a basic working knowledge of *The Super Factory* before you introduce the math problems to your students.

The program is not difficult to learn. If you have had little experience with computers, you may wish to work through the four step-by-step introductory lessons of *The Super Factory*. These lessons have been designed in such a way that they can be used with your students during the introductory stages. They include pre-computer activities and lessons on the "mechanics" of using the software program.

Teaching Tips

Each math lesson and problem has in its teaching guide a list of unique teaching tips.

Student Preparation

Students should be familiar with the following tasks and concepts:

- **Polya's Model**

Use of Polya's four-step problem-solving model as a framework to solve problems.

- ***The Super Factory***

  Pre-computer Activities

  Understand the properties of a cube and the effects of rotations and flips (90°, 180°, 270° and 360°) on symmetrical pictures placed on the faces of a cube.

  Understand the effects of rotations and flips (90°, 180°, 270° and 360°) on asymmetrical pictures placed on the faces of a cube.

  Program Mechanics

  • Research

  Understand the mechanics of the RESEARCH section of the software program *The Super Factory*.

  • Design

  Understand the DESIGN section of the software program, *The Super Factory*.

- **Communication Skills**

Use of writing as a means of documenting their thinking processes in each phase of the model.

Resources

- computers: Apple IIe, IIc or IIGS
- large screen monitor or LCD projection unit
- software program *The Super Factory*
- Cutout Cube Sheet 1 (Appendix D)
- Cutout Cube Sheet 2 (Appendix E)
- Activity Sheet 1 (Appendix F)
- Activity Sheet 2 (Appendix G)
- Polya's Model (blank sheet) (Appendix H)
- glue and/or transparent tape
- scissors

Suggested Activities

- **Understanding and Getting Started**
  - hand out the problem and problem-solving sheets
  - allow students time to read and reread the problem
  - read or have a student read the problem aloud
  - have students load *The Super Factory* into the computer
  - have your students think through the first step of the problem-solving model

To help students along, they can read the questions for understanding the problem, which should lead to clarifying the problem and understanding:

- What is given?
- What information is relevant / irrelevant to the problem?
- Are there hidden assumptions in the problem?
- What is it the student is asked to find?

- **Making A Plan**

In making a plan, you want students to be able to think about ways to solve the problem. Allowing them to talk to each other and work in small groups is desirable.

The teacher should help the students get started in their **own way**, rather than direct the students to the **teacher's way** of thinking. The students should discover a strategy they are comfortable with.

- **Carrying Out the Plan**

Some students will persist in one direction, leading nowhere, if they don't learn to check their progress toward answering the question asked. In carrying out their plan, the teacher should be asking the following kinds of questions as students are working:

- *What* exactly they are doing?
- *Why* they are doing it?
- *How* it is going to help them solve the problem?

After a while, students should begin to check themselves and/or have answers ready before the teacher asks these questions.

- **Looking Back**

The looking back stage should be a rich experience for students. Not only are they stating and checking their answers, but they are asked to look for other reasonable answers.

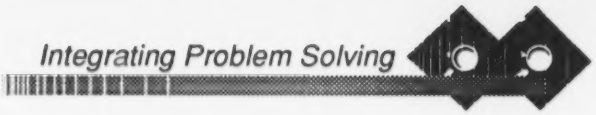
The process as outlined above will serve as a model for your students to follow when they work through the all math problems presented in this guide.

Evaluation

See Chapter 1 for strategies on how to evaluate student problem solving.

Elective Suggestions

Part C – Section 3 of this guide provides students with unlimited problems for remediation or enrichment.



PART C
Section 1 - Research
Elementary and Junior High
Math Problems

Problem 1

The Problem

How many moves will it take to place a picture on each of the faces of the cube?

Understanding the Problem

- How many faces are there on the cube?
- How many faces must you cover?
- What is counted as a move?
- What pictures must you use?
- Do all the pictures have to be different?

Making a Plan

- Do we need a cube to help us practise the moves?

Use Manipulatives or Act Out the Problem

- Should we develop a table to show the moves?

Make an Organized List

- How should we design our table in order to record the moves?

Looking for a Pattern

Carrying Out the Plan

- What section of the program should we use to design the cube?
- Should we use a table to help design the cube?

Looking Back

- How do we know that all the faces on the cube are covered?
- How many moves did it take you to cover all the faces of the cube?
- Could the cube be covered in fewer moves?
- When you turned and flipped the cube, were all the pictures right-side up? Why or why not?
- Would the pictures always seem to be right-side up if they were symmetrical?
- Is there another way to design this cube?

Problem 1

TEACHERS' GUIDE

The Problem
How many moves will it take to place a picture on each of the faces of the cube?

Understanding the Problem

• How many faces are there on the cube?
There are six faces on the cube.

• How many faces must you cover?
You must cover all six faces.

• What is counted as a move?
A move is recorded either when you place a picture on the cube or when you turn or flip the cube.

• What pictures must you use?
It does not matter in this problem.

• Do all the pictures have to be different?
It does not matter in this problem.

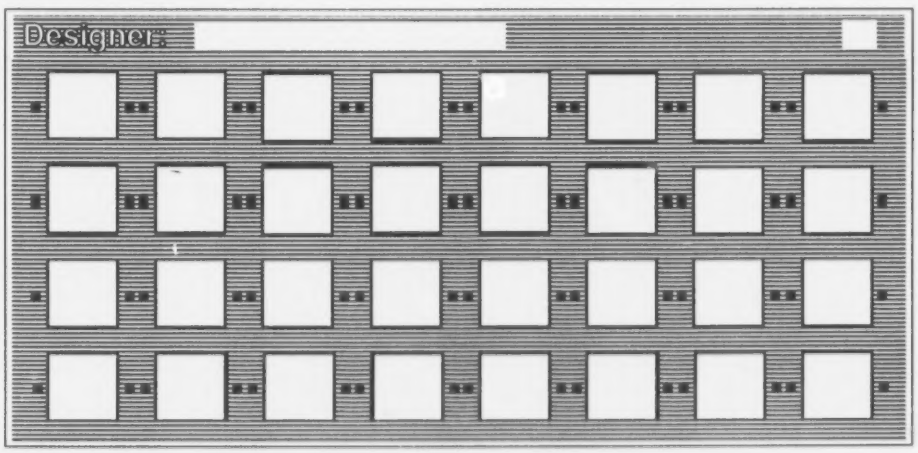
Making a Plan

• Do we need a cube to help us practise the moves?
Use Manipulatives or Act Out the Problem
By using the cube, students can visualize the problem. Use ***Cutout Cube Sheet 3*** (page 3-43). (A master copy is found in Appendix I.)

• Should we use a table to show the moves?
Make an Organized List
The table will help students keep a record of their moves.
• How should we design our table in order to record the moves?

Looking for a Pattern

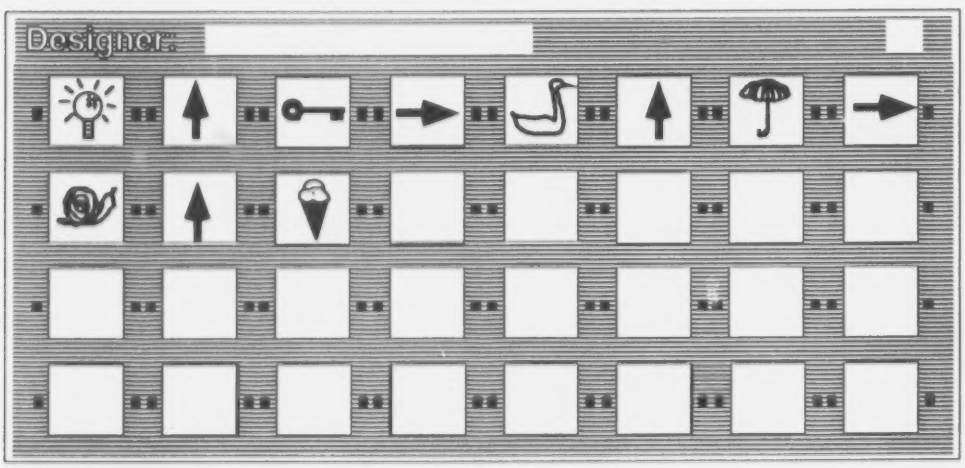
Design your table to help students record their moves by starting with the first picture and ending with the last picture. Use Design Table 1 (page 3-44). (A master copy is found in Appendix J.)



Carrying Out the Plan

- What section of *The Super Factory* should we use to design the cube?
  The Design section of the program will be used.

- Should we use a table to help design the cube.
  This table illustrates one of many solutions.



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Looking Back

• How do we know that all the faces on the cube are covered?
After the cube has been designed, manipulate the cube so the front of the cube is facing you. Now, add four turns to the right and four flips down. This will show all the faces of the cube. Have the student use the STEP command to rotate through the cube. With the final eight moves (four turns and four flips), all faces of the cube will be shown.

• How many moves did it take you to cover all the faces of the cube?
Answers will vary.

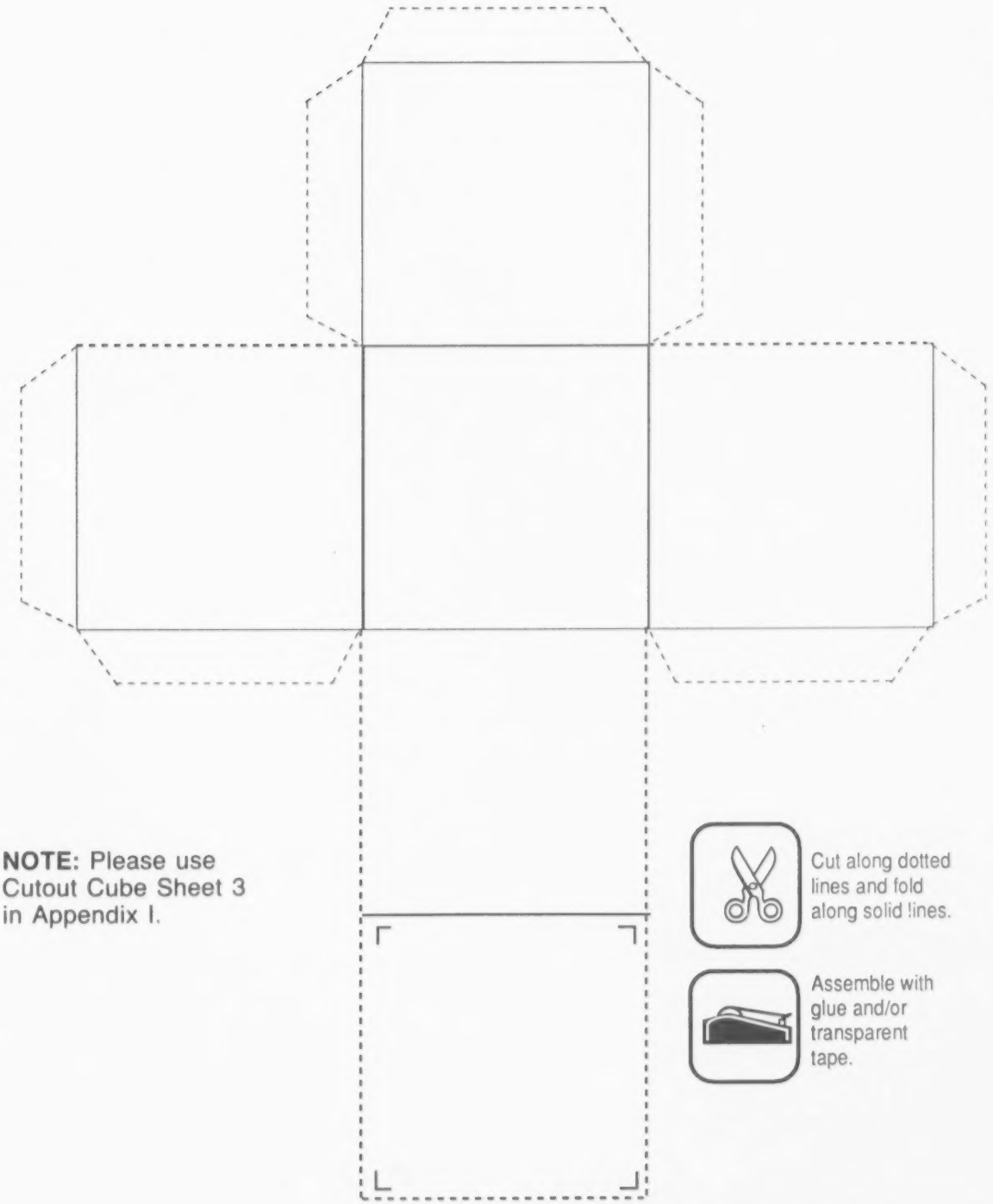
• Could the cube be covered in fewer moves?
The minimum number of moves possible is 11. This can be achieved by a series of rotations and flips.

• When you turned and flipped the cube, were all the pictures right-side up? Why or why not?
If your students used the asymmetrical pictures, they would have noticed that some of the pictures were not always right-side up because they were asymmetrical.

• Would the pictures always seem to be right-side up if they were symmetrical? Why or why not?
All of the pictures would seem to be right-side up because of their universal symmetrical shape. This can be accomplished if the students are asked to replace the pictures following the procedures used in Lesson 3.

• Is there another way to design this cube?
There are an infinite number of ways to design this cube.

Cutout Cube Sheet 3

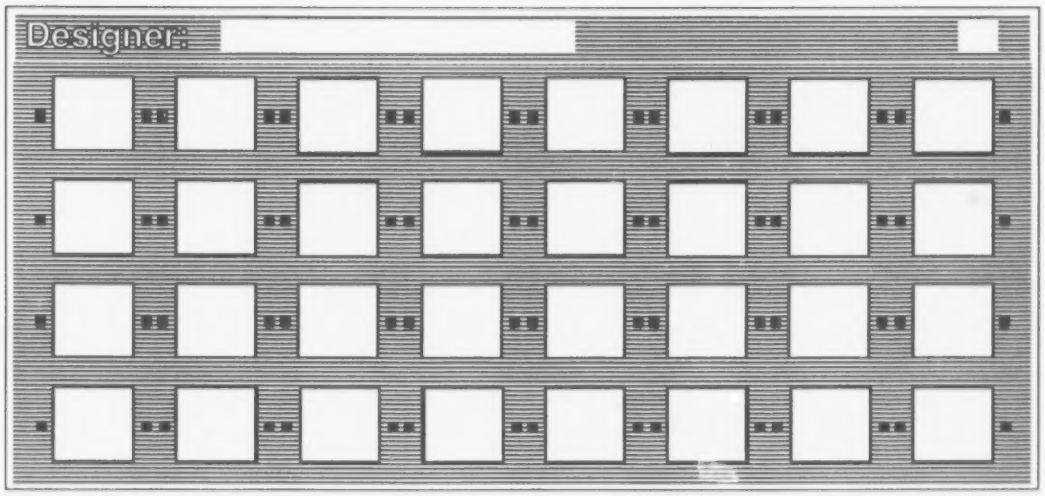


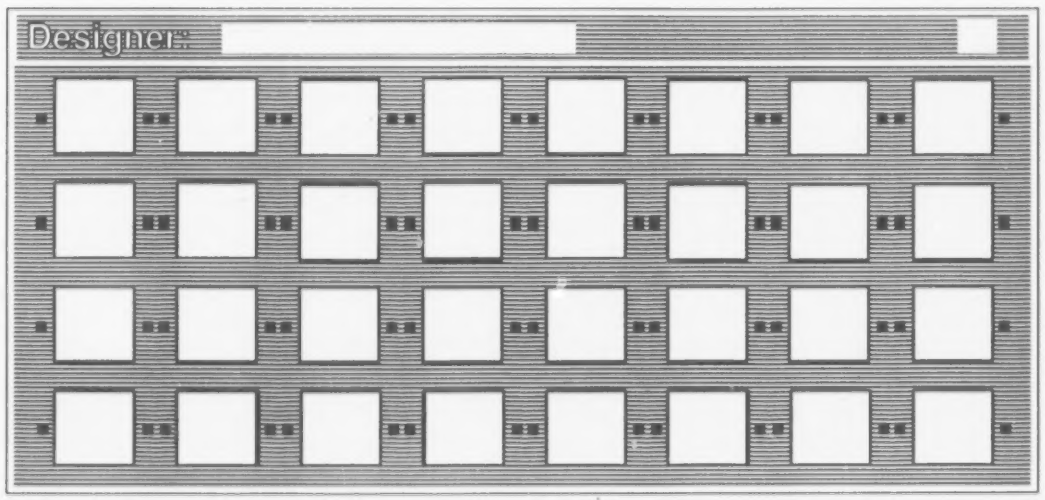
NOTE: Please use Cutout Cube Sheet 3 in Appendix I.

Cut along dotted lines and fold along solid lines.

Assemble with glue and/or transparent tape.

Design Table 1





Problem 2

The Problem

What would be the minimum number of pictures used to cover the entire cube in order that no adjacent faces of the cube would have the same picture? In how many moves can this be accomplished?

Understanding the Problem

- What does "minimum number" mean?
- What does "adjacent faces" mean?
- Is it necessary to cover all the faces of the cube with pictures?
- Can the cube have a different picture on every face?
- Do we have to worry about the symmetry of the pictures?

Making a Plan

- Do we need a cube to help us visualize the problem?

Use Manipulatives or Act Out the Problem

- Should we develop a table to keep track of the moves?

Make an Organized List

- How should we design our table in order to record the moves?

Carrying Out the Plan

Looking for a Pattern

- Where do we get the cube?
- What section of the program should we use to design the cube?
- How should the table be organized to help keep track of the moves?

Looking Back

- What is the minimum number of pictures needed to solve this problem?
- How can we use the program to be sure that the cube is correctly designed?
- Can this be accomplished in fewer moves?

Problem 2

TEACHERS' GUIDE

The Problem

What would be the minimum number of pictures used to cover the entire cube in order that no adjacent faces of the cube would have the same picture? In how many moves can this be accomplished?

Understanding the Problem

• What does "minimum number" mean?
The least number of moves.

• What does "adjacent faces" mean?
An adjacent face on the cube is any face that can be reached in just one turn or flip.

• Is it necessary to cover all the faces of the cube with pictures?
Yes.

• Can the cube have a different picture on every face?
No, because the cube has six faces and the minimum number of pictures is less than six.

• Do we have to worry about the symmetry of the pictures?
No, we do not have to worry about the symmetry of the pictures.

Making a Plan

• Do we need a cube to help us visualize the problem?

Use Manipulatives or Act Out the Problem

Using Cutout Cube Sheet 3 will help the students to understand the concept of adjacent faces on the cube. It will also provide them with concrete material to help them plan the placement of the pictures.

• Should we develop a table to keep track of the moves?

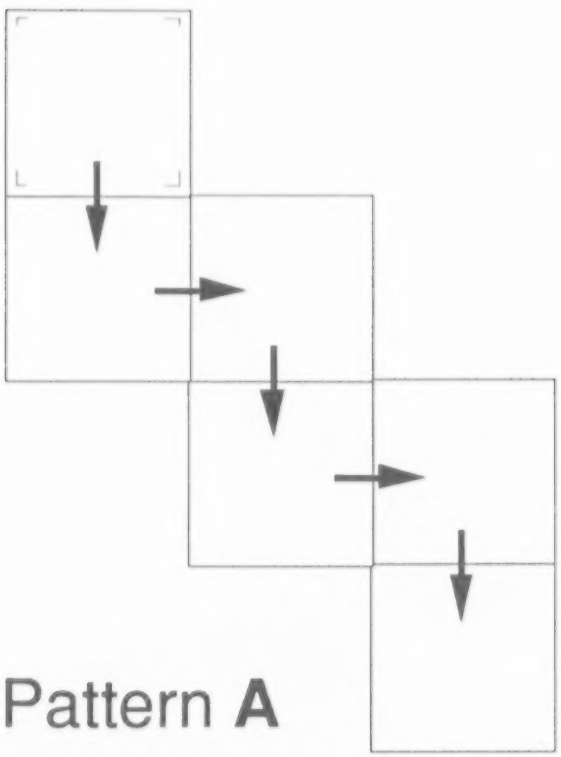
Make an Organized List

The table will help students keep a record of their moves.

• How should we design our table in order to record the moves?

Looking for a Pattern

Use Design Table 2, Pattern A (page 3-57). (A master copy is found in Appendix K.)



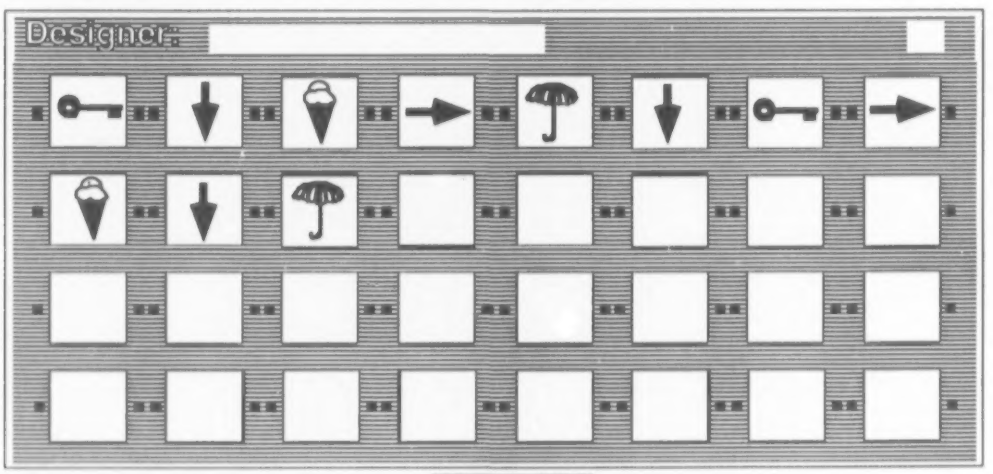
Pattern **A**

Carrying Out the Plan

• Where do we get the cube?
Use Cutout Cube Sheet 3.

• What section of *The Super Factory* should we use to design the cube?
The Design section of the program will be used.

• How should the table be organized to help keep track of the moves?
The following table and Pattern A illustrate a solution to the problem.



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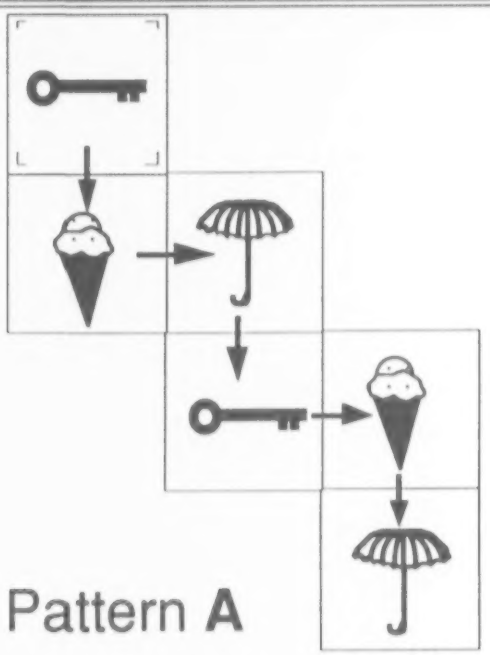

Pattern **A**

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Looking Back

• What is the minimum number of pictures needed to solve this problem?
The minimum number of pictures needed is three.

• Using the program, how can we be sure that the cube is correctly designed?
After the cube has been designed, manipulate the cube so the front of the cube is facing you. Now, add four turns to the right and four flips down.
This will show all the faces of the cube. Have the student use the STEP command to rotate through the cube. With the final eight moves (four turns and four flips) all faces of the cube will be shown.

• Can this be accomplished in fewer moves?
The minimum number of moves is 11.

Problem 3

The Problem

Design a cube that has the LIGHT BULB on the four faces of the cube. The direction of the LIGHT BULB has to rotate 90° with each turn of the cube to the right. How many moves will this design take?

Understanding the Problem

- How many faces of the cube must you cover?
- What picture is to be used to cover these faces?
- What does "rotate the LIGHT BULB" mean?
- Which way must the cube be turned?

Making a Plan

- Do you need a cube to help you understand the problem?

Use Manipulatives or Act Out the Problem

- Would it help if you had a cube with the LIGHT BULB rotated on the faces?

Working Backwards

- Should we develop a table to show the moves?

Make an Organized List

- How should we design our table in order to record the moves?

Looking for a Pattern

Carrying Out the Plan

- With pencil and paper, or by using **Cutout Cube Sheet 3** make a cube that solves the problem.
- Record the moves needed to solve the problem.

Looking Back

- Does the LIGHT BULB rotate as the cube is turned 360°?
- How many moves did it take you? Can it be done in fewer moves?
- Can this problem be solved using a CIRCLE as the picture? Why or why not?

Problem 3

TEACHERS' GUIDE

The Problem

Design a cube that has the LIGHT BULB on the four faces of the cube. The direction of the LIGHT BULB has to rotate 90° with each turn of the cube to the right. How many moves will this design take?

Understanding the Problem

• How many faces of the cube must you cover?
Four faces must be covered.

• What picture is to be used to cover the faces?
The LIGHT BULB.

• What does "rotate the LIGHT BULB" mean?
The direction of the LIGHT BULB changes as the cube is turned.

• Which way must the cube be turned?
The cube must be turned to the right.

Making a Plan

• Do you need a cube to help you understand the problem?

Use Manipulatives or Act Out the Problem

The cube is a valuable tool to help students understand the nature of the problem. Cutout Cube Sheet 3 could be used by the students to make this cube.

• Would it help if you had a cube with the LIGHT BULB rotated on the faces?

Working Backwards

A cube with the correct design would be very useful for the students. This would act as a starting point for them. Remember that every time you place a picture on the cube face it will be right-side up. It is the cube that must be flipped and rotated rather than the picture.

•Should we develop a table to show the moves?

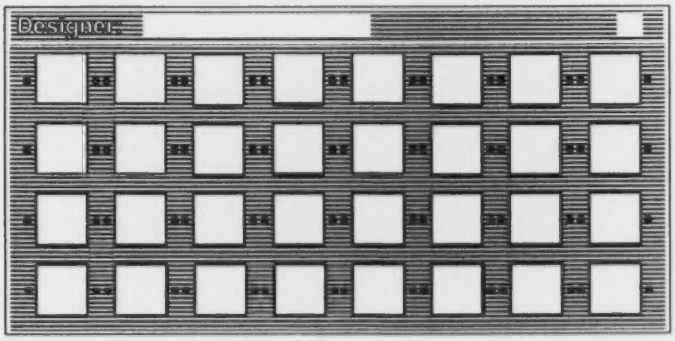
Make an Organized List

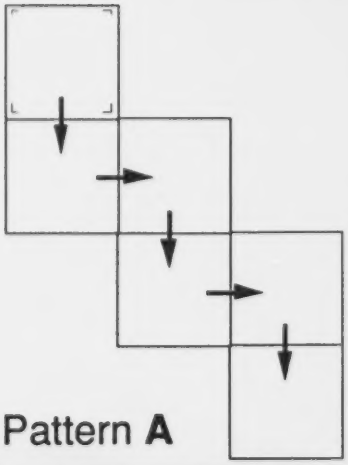
Recording of the data is very helpful for the students when they design this cube using the program. Learning to record data is also a useful skill to develop for real-life situations.

• How should we design our table in order to record the moves?

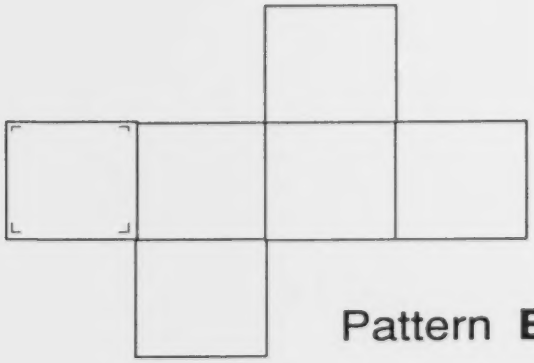
Looking for a Pattern

Use Design Table 2, Patterns A and B (page 3-57). (A master copy is found in Appendix K.)





Pattern **A**



Pattern **B**

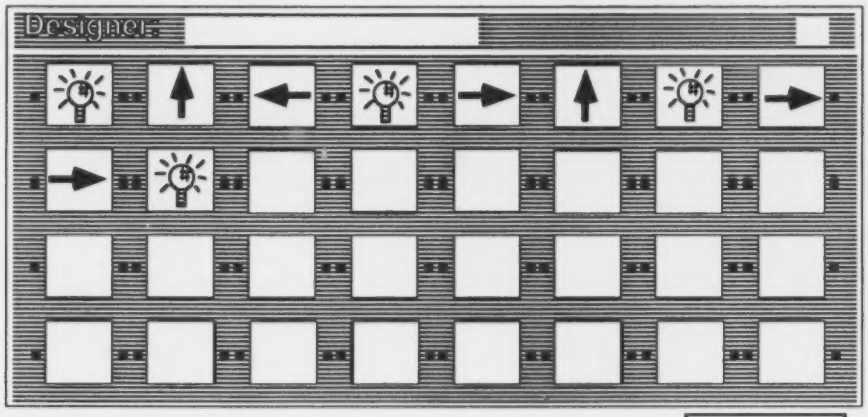
Carrying Out the Plan

- With pencil and paper, or by using Cutout Cube Sheet 3, make a cube that solves the problem.

Use the cube that was generated from the Cutout Cube Sheet 3 and physically draw in the LIGHT BULB, rotating it as the cube is turned.

- Record the moves needed to solve the problem.

Using one of the following tables, have the students record the pictures and moves.



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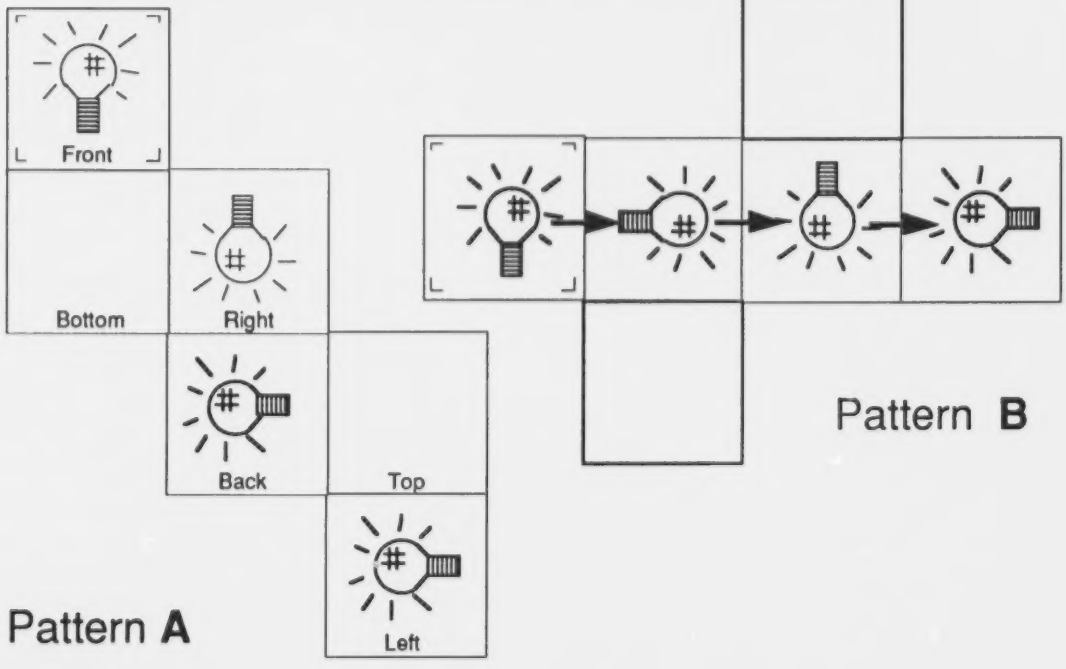


Pattern **A**

Pattern **B**

* Adapted with permission from *The Super Factory Teacher's Guide*. WINGS for learning, © 1990.

Looking Back

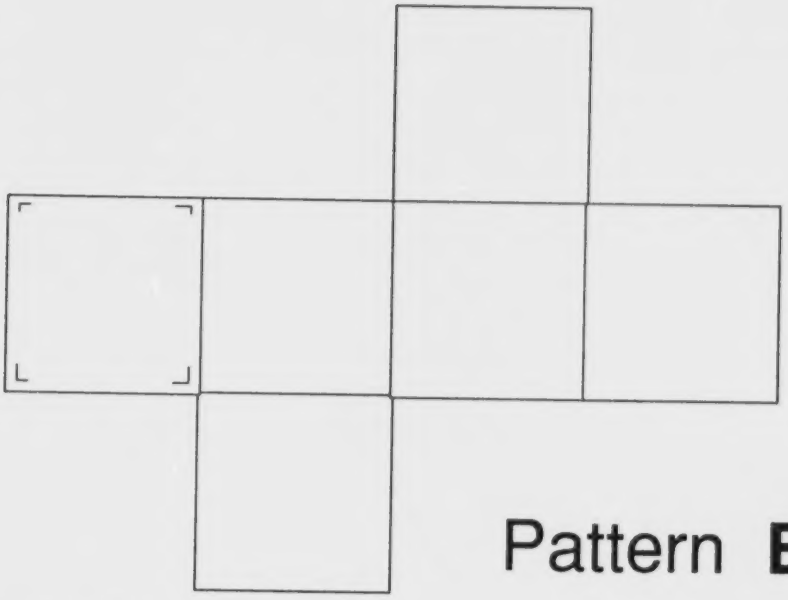
• Does the LIGHT BULB rotate as the cube is turned 360°?
Yes, the LIGHT BULB will rotate.

• How can you check to see if this really happens?
Yes, the LIGHT BULB will rotate and this can easily be checked by returning to the front of the cube and then turning the cube to the right four times (360°).

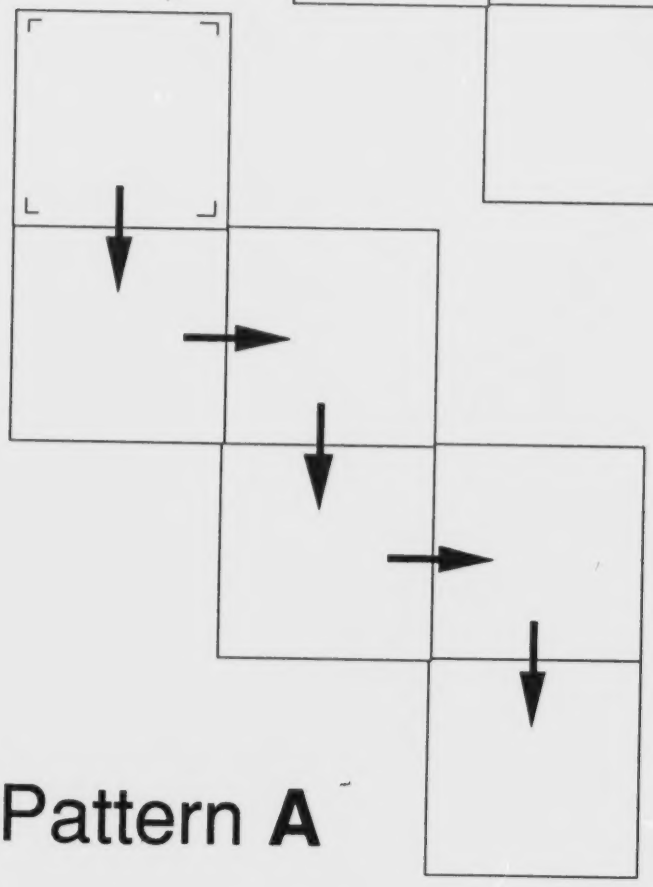
• How many moves did it take you? Can it be done in fewer moves?
Ten moves is the least number of moves.

• Can this problem be solved using a CIRCLE as the picture? Why or why not?
This type of problem cannot be solved by using a CIRCLE because it is symmetrical and does not have direction.

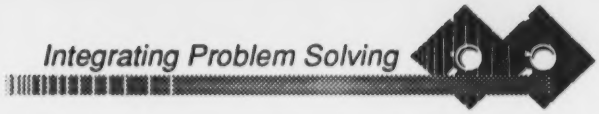
Design Table 2



Pattern **B**



Pattern **A**



PART C
Section 2 - Design
Elementary and Junior High
Math Problems

Problem 4

The Problem

How many moves will it take to put pictures on the following faces: front, top and bottom? Is there more than one way to complete this task?

Understanding the Problem

Making a Plan

Carrying Out the Plan

Looking Back

Problem 5

The Problem

Using symmetrical pictures only, cover the following faces of the cube: left side, bottom and back. In how many moves was this accomplished?

Understanding the Problem

Making a Plan

Carrying Out the Plan

Looking Back

Problem 6

The Problem

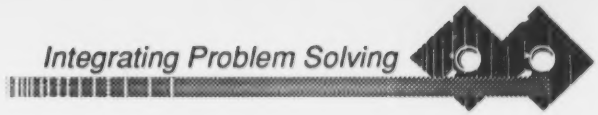
Place an asymmetrical picture with the direction right-side up on the back face of the cube. What type of moves were used?

Understanding the Problem

Making a Plan

Carrying Out the Plan

Looking Back



PART C
Section 3 - Challenge Elementary and Junior HighMath Problems

Challenge Problems

The Problem
Use the Challenge section of *The Super Factory* to create the problems and Polya's model to outline and solve the problem.

Understanding the Problem

ANALYZE screen is used.

- How can you control the movement of the cube?
- What is the problem?
- What does "duplicate" mean?
- Are all the pictures asymmetrical?
- What is the direction of the pictures?

Making a Plan

ANALYZE and PLAN screens are used.

- Would it help if you could study the cube in slow motion?
- Do you need a cube to help you understand the problem?

Use Manipulatives or Act Out the Problem

- Would it help if you had a cube with correct pictures on the correct faces?

Working Backwards

- Should we develop a table to show the moves?

Make an Organized List

- How should we design our table in order to record the moves?

Looking for a Pattern

Carrying Out the Plan

ANALYZE, PLAN and TRY screens are used.

- How can you control the movement of the cube?
- Where can you keep track of the moves?
- How can you construct a model of the cube?

Looking Back

CHECK screen is used.

- Are the cubes the same?
- Are the number of moves the same?
- Can the number of moves be the same but the plans still ditfer?
- What helped you the most in solving the problem?

Challenge Problems

TEACHERS' GUIDE

The Problem
Use the Challenge section of *The Super Factory* to create the problems and Polya's model to outline and solve the problem.

Teaching Tips

The CHALLENGE section of ***The Super Factory*** presents students with a variety of problems classified from Easy to Super.

In each instance, a problem is presented consisting of pictures placed on a cube. Students are then asked to reproduce the cube in the required number of moves.

Each section of the Challenge part of the program has four SCREENS: **ANALYZE, PLAN, TRY and CHECK.**

ANALYZE Screen
A cube will appear in the top right-hand corner and start rotating on the screen. In order for the students to control the movement of the cube, they should press RETURN. This will cause the cube to return to the front face.

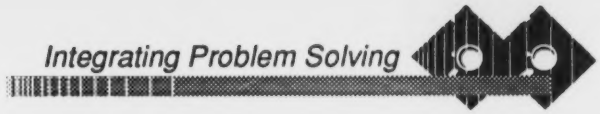
The students can now control the movement of the cube by using the APPLE and the arrow keys.

The problem is a challenge to the students to duplicate the cube that is presented by the computer.

This screen allows the students to study the cube they must duplicate. Once the analysis is completed, the students move on to the second screen by highlighting PLAN and pressing RETURN.

PLAN Screen
This screen shows two plans. The visible plan is used by the students to develop their solutions. The invisible plan is the one completed by ***The Super Factory***. The number of moves for each of the plans is recorded in the upper right-hand corner.

This screen also displays five options: PICTURE, TURN, EDIT, HELP and TRY. The only new option presented is the HELP option. This option provides assistance to the students at three levels:



HELP 1
- Allows for rotation of the challenge cube. This will allow the students to check their plans as they manipulate the challenge cube. This is very useful for the students who used a Guess and Check strategy. This level can be accessed at any time when using the PLAN screen.

HELP 2
- Allows for the rotation of both cubes simultaneously. This is another way of visualizing whether the cubes match. This level should be used only after a plan for the cube has been tried (when using the TRY screen).

HELP 3
- Allows for viewing of the plan completed by the computer. This option could be used when the plan is too difficult for the students or to compare the number of moves made by the students to those generated by the program. This level can be accessed anytime and should be used to prevent student frustration. This level supplies the solution to the problem.

Once the students have completed their plans, they move on to the TRY screen by highlighting the TRY option on the plan screen and pressing RETURN.

TRY Screen
A blank cube appears in the top right-hand corner of the screen and then the computer will carry out the plan you designed. In order to check the cube you would select the STEP option on the screen. This option slows down the execution of the plan. The next thing to do is to move on to the CHECK screen.

This is done by highlighting the CHECK option on the screen.

CHECK Screen
This is where the cubes are compared by the computer. The students are informed as to whether or not the cubes are the same. If the cubes are different the computer allows the student to go back to the PLAN screen to do the necessary editing. If the cubes are the same the computer then displays the number of moves it took the students to accomplish the required cube as well as the level(s) of help the students used.

In the previous lessons of this guide, time was spent analyzing the cube, Polya's Problem-Solving Model and strategies used to solve problems. This section of the guide employs this knowledge.

The teacher should direct the students to select the CHALLENGE part of the program. The students should then select a problem from the EASY section of the menu.The students will be asked by the program to identify themselves by typing in their names or their group's name. **The teacher should guide the students through the first problem in order to demonstrate the mechanics of this section of the program.**

In order to accept another challenge, the student highlights QUIT, which brings back the Main Menu.

Understanding the Problem

ANALYZE screen is used.

• How can you control the movement of the cube?
Control of the movement is accomplished by using the APPLE and arrow keys.

• What is the problem?
The problem is two-fold: to duplicate the pictures on the cube and to accomplish this in the required number of moves. However, the teacher should first concentrate on getting the pictures placed correctly. Then, if the teacher feels that the class can handle the second part of the challenge, it should be given.

• What does "duplicate" mean?
To make a cube identical to the one that was generated by the program.

• Are all the pictures asymmetrical? *Unless the program has been altered, all pictures are asymmetrical.*

• What is the direction of the pictures?
This will vary from problem to problem.

Making a Plan

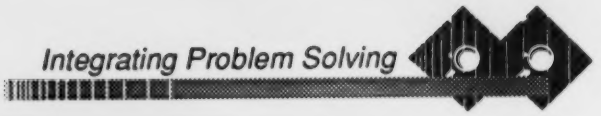
ANALYZE and PLAN screens are used.

• Would it help if you could study the cube in slow motion?
This should be very beneficial for the students when they try to develop their designs.

• Do you need a cube to help you understand the problem?
Use Manipulatives or Act Out the Problem
This would depend upon the level of difficulty the students are encountering during their study of the challenge cube. A cube is very useful when doing problems at the higher levels of the Challenge section.

• Would it help if you had a cube with correct pictures on the correct faces?
Working Backwards
This strategy is very useful with the more difficult problems, especially when trying to design the cube in the suggested number of moves.

• Should we develop a table to show the moves?
Make an Organized List
A table to record the moves would be very beneficial for the students. This demonstrates how planning helps to solve a problem.



• How should we design our table in order to record the moves?

Looking for a Pattern

In order to determine patterns, the students should use their tables or patterns previously developed in earlier lessons. This ensures consistency when they are doing these problems.

Carrying Out the Plan

ANALYZE, PLAN and TRY Screens are used.

• How can you control the movement of the cube?
By holding down the APPLE key and using the arrow keys to turn and flip the cube.

• Where can you keep track of the moves?
The table supplied in this guide would be an ideal place to record the moves.

• How can you construct a model of the cube?
Using the Cutout Cube Sheet 3 will give the students a three-dimensional model of a cube; or, if they prefer a two-dimensional model, then they could use either of the two patterns supplied. The students would then rotate the cube in the ANALYZE screen and thus record where the pictures are on the cube. Using a model, the students could then determine how to turn and/or flip the cube in order to place the pictures on the correct faces and in the correct directions.

Looking Back

CHECK screen is used.

• Are the cubes the same?
The first concern is to determine if the cubes are similar. If they are, proceed to the next question. If they are different the students should be encouraged to return to the PLAN screen and edit their plans after they have sought assistance from the program's HELP option.

• Are the number of moves the same?
The next step is to see if the number of moves are the same. The program will always generate the challenge cube in the least number of moves. If the number of moves is the same, the students should proceed. However, if it is not, the teacher should decide if it is appropriate for the students to try to accomplish this feat. This would also depend upon the level of challenge the students are using. They would have to return to the PLAN screen and with the use of the model, patterns and table try to minimize the number of moves.

• Can the number of moves be the same but the plans still differ?
The plans may differ in the sequencing of the moves.

• What helped you the most in solving the problem?
The answers will vary depending on the students' learning styles.

Polya's four-step model should be used by the teacher when dealing with problem solving, and the students should be encouraged to use it all the time. The teacher has now reached a point where most of the students can proceed with the program to solve more complex problems generated by *The Super Factory*.

INTEGRATING BY USING APPLICATION SOFTWARE

APPLEWORKS or MICROSOFT WORKS

Integrating *"WORKS"* *	3-73
Part A – Section 1 Elementary Math Problems	3-79
Part A – Section 2 Elementary Math Problems	3-109
Part B – Section 1 Junior High Math Problems	3-123
Part B – Section 2 Junior High Math Problems	3-155

* Throughout this section *"WORKS"* can be taken to mean either *AppleWorks* or *Microsoft Works.*

Grade Level
Divisions II and III

Strand
Problem Solving–Divisions II and III

Learner Expectation
Demonstrate effective use of *"WORKS"* in all stages of mathematical problem solving.

Clarification of Expectation/Description
Six elementary and six junior high school level problems have been developed to illustrate how *"WORKS"* can be integrated into Division II and Division III mathematics courses using Polya's problem-solving model.

Tables 1 and 2 on page 3-74 list the problems contained within this guide. Also indicated are the various math content strands and the *"WORKS"* application program(s) used with each problem.

The elementary and the junior high math problems listed in Section 1 of both Parts A and B include questions to help the students work through each problem. In addition, each problem has teacher notes, a teacher answer guide and the *WORKS* files used for solving the problem. The math problems listed in Section 2 of both Parts A and B contain only the problem, some teacher notes and the *"WORKS"* files that accompany the problem.

Teacher Preparation
It is important that you have a basic working knowledge of the *"WORKS"* program before you introduce the math problems to your students.

Part A — Elementary Mathematics

Problem Solving

	Math Content Strands					Integration of "WORKS"		
	Numeration	Operations & Properties	Measurement	Geometry	Graphing	Word Processor	Spreadsheet	Database
SECTION 1								
Play It Again Sam	■	■					■	
Paper Packing Penny Pincher	■	■				■	■	
Let's Party	■	■			■	■	■	■
SECTION 2								
The Club Has Arrived		■	■			■	■	
Shaping Up With Clay	■	■			■	■	■	
Subject Survey	■	■	■		■	■		■

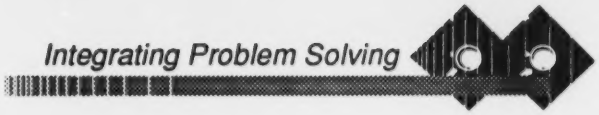
Table # 1

Part B — Junior High Mathematics

Problem Solving

	Math Content Strands					Integration of "WORKS"		
	Numeration	Operations & Properties	Measurement	Geometry	Graphing	Word Processor	Spreadsheet	Database
SECTION 1								
Dance for Donations	■	■			■		■	
Super Skateboard Shopper	■	■		■	■	■	■	
Happy Trails to You	■	■		■	■	■	■	■
SECTION 2								
A Frame Up	■		■		■	■	■	
You Can Bank On It	■	■			■	■	■	
TV Poll	■	■		■	■	■		■

Table # 2



• **Learning *"WORKS"***

"WORKS" is an integrated software program that puts together the three most popular productivity applications for the computer: a word processor, a database and a spreadsheet.

You can quickly learn the basic operations of *"WORKS"* by following the training disk that comes with the program. The training disk guides you through a simulation of the basic features right on your computer. The training program gently monitors your progress, poses problems and helps you solve them. In addition a guide also comes with the program which picks up where the training disk leaves off. With this guide, you'll work through more features of *"WORKS,"* using the software. Also accompanying the program is the reference manual, which will provide you with detailed, step-by-step procedures for using the program.

• **Teacher and Student *"WORKS"* Files**

Included with this mathematical problem-solving guide are a student and a teacher disk with files for all problems and activities.

For every Section 1 math problem, the student disk contains three different types of files: (1) a word processing file containing the math problem with a blank shell of Polya's model, (2) a word processing file containing the math problem with a list of student questions under each step of Polya's model and (3) a spreadsheet and/or the database file to help the students solve the problem.

All Section 2 math problems on the student disk contain two files: (1) a word processing file that has the math problem followed by a blank shell of Polya's model, which the students are to fill in, and (2) a spreadsheet and/or the database file to help the students solve the problem.

The disks are not copy protected. As a result, you are welcome to make as many copies of them as you need for your class. Moreover, you are encouraged to modify the files. Because all student problems and questions are on *"WORKS"* files you can easily make changes to them to best suit your individual needs.

Teaching Tips

Each math problem includes a teacher's guide, with a list of unique teaching tips.

Student Preparation

Teachers should teach the *"WORKS"* program functions as an integral part of the math lesson and not in isolation. Junior high school math teachers are encouraged to work closely with the school's computer teacher. Together you can develop lessons in which the computer skills taught in the computer classroom are integrated into your math program.

Students should be familiar with the following tasks and concepts:

- **Polya's Model**

Use of Polya's four-step problem-solving model as a framework to solve problems.

- ***"WORKS"* Functions**

General:

Loading the *"WORKS"* program
Opening a new file (adding a file to the desktop)
Switching between files on the desktop
Saving a file
Printing a file
Quitting

Word Processing:

Basic knowledge of the processes of moving, deleting and copying text

Spreadsheet:

Anatomy of a spreadsheet
Moving through the spreadsheet
Entering information in a cell
Editing an existing entry

Database:

Anatomy of a database
Entering and editing information
Finding and selecting certain records

- **Communication Skills**

Use of writing/word processing as a means of documenting their thinking processes in each phase of the model.

Resources

- computers: Apple IIe, IIc or IIgs (*AppleWorks*); PC or Macintosh (*Microsoft Works*)
- software program *AppleWorks* or *Microsoft Works*
- copies of student problem-solving disks
- access to printer(s)

Suggested Activities

- **Understanding and Getting Started**
  - hand out the problem and problem-solving sheets;
  - allow students time to read and reread the problem;
  - read or have a student read the problem aloud;
  - have students load the *"WORKS"* file containing the problem (the blank shell or the file with the prepared questions); and,
  - have your students think through the first step of the problem-solving model.

Students can read the "questions for understanding the problem and getting started," which should lead to clarifying the problem and understanding:

- what is given;
- what information is relevant/ irrelevant to the problem;
- whether there are hidden assumptions in the problem; and,
- what the student is asked to find.

- **Making a Plan**

In making a plan, you want students to be able to think about ways to solve the problem. Allowing them to talk to each other and work in small groups is desirable.

The teacher should help the students get started in their **own way**, rather than direct the students to the **teacher's way** of thinking. The students should discover a strategy they are comfortable with.

After this process, the value of using the computer should be discussed.

- **Carrying Out the Plan**

Some students will persist in one direction, leading nowhere, if they don't learn to check their progress toward answering the questions asked. In carrying out their plan, the teacher should be asking the following kinds of questions as students are working:

- *What* exactly are they doing?
- *Why* are they doing it?
- *How* is it going to help them solve the problem?

After awhile, students should begin to check themselves and/or have answers ready before the teacher asks these questions.

- **Looking Back**

The looking back stage should be a rich experience for students. Not only are they stating and checking their answers, but they are asked to look for other reasonable answers.

The intent of the suggested questions is also to have students:

- manipulate the information to answer related questions,
- reflect on the computer as a useful problem-solving strategy, and
- encourage students to create and make up new problems.

- **Enrichment**

Students should gradually be weaned from a spreadsheet and/or database prepared in advance to setting up their own spreadsheet and/or database from scratch.

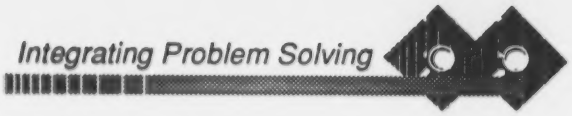
The process outlined above will serve as a model for your students to follow when they work through all math problems presented in this guide.

Evaluation

See Chapter 1 for strategies on how to evaluate students' problem solving.

Elective Suggestions

The problems in Section 1 contain numerous questions for extending the problem in the Looking Back procedure of Polya's model. These questions should provide you with many ideas as to how the math problems in Section 2 can also be extended.



Part A
Section 1
Elementary Math Problems

Division II
Play It Again Sam

THE PROBLEM

You would like to buy a personal cassette player. The cassette player costs $29.99. You receive an allowance of $5 a week. The purpose for your allowance is to buy your treats (candy, gum, drinks, etc.), as well as to save money to buy special things. How much can you save each week from your allowance to purchase the personal cassette player in seven weeks? 12 weeks? 20 weeks?

Personal Cassette Player!
Limited time offer!
While Supplies Last!
$29.99
"Crazy Sam"
Crazy Sam's Stereo Warehouse
• Located in the Alberta Mall • Phone 555-2319 • Open 9 to 9 • 7 days a week•

Understanding the Problem

- What do I want to buy?
- How much does it cost?
- Where will I get the money?
- What is the purpose of my allowance?
- How much can I save from my allowance?

Making a Plan

- What do I need to find?
- Can I make a chart?
- Can I use guess and check?
- Can I use a computer?
- Think about a reason for my plan.

Carrying Out the Plan

- What information do I need to organize?
- How can a spreadsheet help me solve the problem?
- What would the spreadsheet look like?
- What will the spreadsheet have to calculate?

...using a Spreadsheet

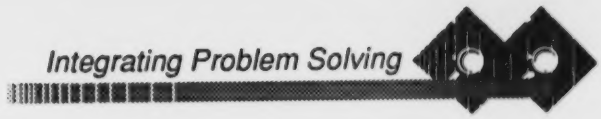
- I can use the **"SAM"** spreadsheet to help me solve the problem.

- I need to think about my plan:
  - *What* exactly am I doing?
  - *Why* am I doing it?
  - *How* is it going to help me solve the problem?

- Print a copy of the completed spreadsheet to hand in to the teacher.

Looking Back

- Did I answer the questions asked?
- What decisions did I make along the way?
- Are my answers reasonable?
- Are there other reasonable answers?
- What did I do to shorten the period?
- What happened when I spent more of my allowance on treats?
- What part of my weekly allowance am I saving?



- How many weeks would it take to save enough money if I saved $2 each week?
- Would it be possible to buy the cassette player in less than seven weeks? Why or why not? Is it reasonable?
- It doesn't take any longer to buy the cassette player if I spend $2.40 per week or if I spend $2.60 per week. Does something similar happen anywhere else in the chart? Why or why not?
- What is the greatest amount I can spend each week on treats to have enough money to buy the cassette player in 20 weeks?
- Am I spending the maximum amount of money on treats for each period?
- If my allowance increased to $7 per week, how would it change the number of weeks I need to save the $29.99 to buy the cassette player?
- How did the spreadsheets help me solve the problem?
- Could the spreadsheets be set up differently?
- What else could I do with this spreadsheet?
- Can I write a different problem that could be solved using this spreadsheet?

Division II
Play It Again Sam

TEACHERS' GUIDE

THE PROBLEM

You would like to buy a personal cassette player. The cassette player costs $29.99. You receive an allowance of $5 a week. The purpose for your allowance is to buy your treats (candy, gum, drinks, etc.), as well as to save money to buy special things. How much can you save each week from your allowance to purchase the personal cassette player in seven weeks? 12 weeks? 20 weeks?

Teaching Tips

This problem integrates two strands of the elementary math curriculum with the spreadsheet.

First, introduce the **Play It Again Sam** problem to your students using Polya's model. There are several ways of doing this. The method you choose should be based on your own teaching style and the problem-solving skill level of your students (see the "Suggested Activities" section on page 3-77 for some ideas).

In Appendix H there is a blank shell of Polya's model to be duplicated for your students. They can write their responses directly on this sheet.

If your students require more assistance in solving the problem, you may wish to provide them with the student master sheet that contains a series of prepared questions to help them write their responses under each step of Polya's model.

During the **Carrying Out the Plan** procedure introduce the **SAM** spreadsheet.

- Students enter information into the Treats cell of the spreadsheet. The spreadsheet will automatically calculate the Amount Saved and the Number of Weeks.

Students should use the spreadsheet like a table or a chart to compare the differences that occur when various options are chosen.

Understanding the Problem

- What do I want to buy?
The personal cassette recorder.

- How much does it cost?
$29.99.

- Where will I get the money?
From the weekly allowance.

- What is the purpose of my allowance?
To buy treats and special items.

- How much can I save from my allowance?
The answers will vary.

Making a Plan

- What do I need to find?
How much you will need to save each week to purchase the cassette player in seven, 12 and 20 weeks.

- Can I make a chart?
A chart would help to organize the information.

- Can I use guess and check?
Yes, but it could take a lot of guesses and calculations.

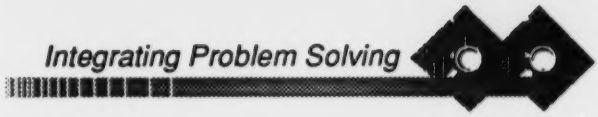
- Can I use a computer?
A spreadsheet would be an efficient way to organize the information, manipulate and make changes in one thing at a time, and analyze the effects on the amount saved and the number of weeks.

- Students should think about a reason for their plan.

Carrying Out the Plan

- What information do I need to organize?
The amount spent on treats and the amount saved.

- How can a spreadsheet help me solve the problem?
A spreadsheet would be useful to organize the information in a chart and do the calculations. The chart allows for visual comparisons as the amounts of monies are changed in the treats column.



- What would the spreadsheet look like?
It will show the cost of the cassette player, the weekly allowance, the money spent on treats, the amount saved and the number of weeks it takes.

- What will the spreadsheet have to calculate?
The amount you can save as well as the number of weeks it will take you to purchase the personal cassette player.

...using a Spreadsheet

- Use the **SAM** spreadsheet to help solve the problem.

- Teachers should ask students to think about their plan as they go along and be prepared to explain:
  - *What* exactly they are doing.
  - *Why* they are doing it.
  - *How* it is going to help them solve the problem.

- Students should print a copy of their completed spreadsheet to hand in to the teacher.

Looking Back

- Did I answer the questions asked?
Students should state their final answers in complete sentences: the amount they save will vary for each student and period.

- What decisions did I make along the way?
The amount spent on treats.
The amount saved each week.

- Are my answers reasonable?
The amount spent on treats.

- Are there other reasonable answers?
Yes, depending on the amount spent on treats.

- What did I do to shorten the period?
Spend less.

- What happened when I spent more of my allowance on treats?
It took longer.

- What part of my weeky allowance am I saving?
Students can express their answers as fractions, decimals or percentages.

- How many weeks would it take to save enough money if I saved $2 each week?
Fifteen weeks.

- Would it be possible to buy the cassette player in less than seven weeks? Why or why not? Is it reasonable?

You could do it if you spent very little on treats but this may not be reasonable.

- It doesn't take any longer to buy the cassette player if I spend $2.40 per week or if I spend $2.60 per week. Does something similar happen anywhere else in the chart? Why or why not?

Yes, because the number of weeks is rounded to the nearest week .

- What is the greatest amount I can spend each week on treats to have enough money to buy the cassette player in 20 weeks?

$3.53.

- Am I spending the maximum amount of money on treats for each period?

Answers will vary, but students will need to manipulate their spreadsheets.

- If my allowance increased to $7 per week, how would it change the number of weeks I need to save the $29.99 to buy the cassette player?

It should take less time or students will spend more on treats.

- How did the spreadsheets help me solve the problem?

The calculations were done very quickly .
Many different combinations could be analyzed and the most suitable choices made.
The information was organized so it was easy to see and work with.

- Could the spreadsheets be set up differently?

Encourage the students to discuss other ways.

- What else could I do with this spreadsheet?

Use it for other things the students may want to save for.
Allow individual students to input their own allowance.
Allow individual students to input the amount of money they spend on treats.
Allow students to determine how soon they want to make their purchase.

- Can I write a different problem that could be solved using this spreadsheet?

Encourage students to write and solve their own problems.

Division II
Paper Packing Penny Pincher

THE PROBLEM

Jan would like a job delivering newspapers. There are three newspapers advertising for carriers in your neighbourhood: 1) the evening paper - the Daily Blab, 2) the morning paper - the Early Bird and 3) the Saturday paper - the Weekender.

a. Jan needs to decide whether to work every day, or just on Saturdays. Help Jan make the decision. Find out how long she would have to work on Saturdays, to earn at least as much as she would delivering papers one hour each day for the Daily Blab? the Early Bird? (Express your answer to the nearest hour.)

b. Decide which newspaper you would like to apply to. Write a paragraph giving at least three reasons for your choice.

The Daily Blab

Deliver papers anytime
between 3:30-5:30 p.m. daily
We will pay you:
12¢ per paper (Monday to Friday)
17¢ per paper (Saturday & Sunday)

Contact Linda Carrier Manager
at 555-0003

The Early Bird is looking for Delivery Persons

Delivery time:
Anytime between 5:00a.m.- 7:00a.m.

WE PAY:
40¢ per paper (Monday to Friday)
50¢ per paper (Saturday and Sunday)

Please respond in person at the Early Bird Office during regular hours

The Weekender

Great part-time work!
Deliver papers on Saturday only!
We pay 33¢ per paper
Call Ron at 555-1233

Understanding the Problem

- What do I want to do?
- What are my choices?
- What am I given?
- What am I asked to find?
- What am I asked to do?

Making a Plan

- Can I make a chart?
- Can I use guess and check?
- Can I use a computer?
- Think about a reason for my plan.

Carrying Out the Plan

- What information do I need to organize?
- How can a spreadsheet help me solve the problem?
- What would the spreadsheet look like?
- What will the spreadsheet have to calculate?

...using a Spreadsheet

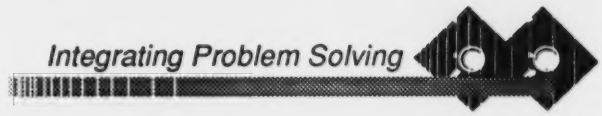
- I can use the **PAPER** spreadsheet to help me solve the problem.

- I need to think about my plan:
  - *What* exactly am I doing?
  - *Why* am I doing it?
  - *How* is it going to help me solve the problem?

- Print a copy of your completed spreadsheet to hand in to the teacher.

Looking Back

(a)
- Did I answer the questions asked?
- What decisions did I make along the way?
- Are my answers reasonable?
- Are there other reasonable answers?
- What happened to the length of time and total earnings when the number of papers was increased? decreased?
- Compare the minutes per day and the earnings for the Early Bird and the Daily Blab? the Daily Blab and the Weekender?



- Compare the earnings for the two daily papers if there were 30 of each.
- Would it be possible to deliver 60 daily newspapers? Why or why not?
- What is the maximum number of papers that Jan could deliver working no longer than 75 minutes on Saturdays? two hours on Saturdays?
- If Jan wanted to earn at least $25 per week, what is the least number of papers she would have to deliver for the Daily Blab? the Early Bird? The Weekender? Are your answers reasonable?
- How many minutes does it take to deliver one Daily Blab newspaper? one Early Bird? one Weekender? Why do you think they are different?
- How did the spreadsheet help me solve the problem?
- How did the spreadsheet calculate the total earnings for each paper?
- How did the spreadsheet calculate the number of minutes per day for each paper? Are they the same?
- How did the spreadsheet calculate the hours per week?
- Could the spreadsheet be set up differently?
- What else could I do with this spreadsheet?
- Can I write a different problem that could be solved using this spreadsheet?

(b) Decide which newspaper you would like to apply to. Write a paragraph giving at least three reasons for your choice.

Division II
Paper Packing Penny Pincher

TEACHERS' GUIDE

THE PROBLEM

Jan would like a job delivering newspapers. There are three newspapers advertising for carriers in your neighbourhood: 1) the evening paper - the Daily Blab, 2) the morning paper - the Early Bird and 3) the Saturday paper - the Weekender.

a. Jan needs to decide whether to work every day, or just on Saturdays. Help Jan make the decision. Find out how long she would have to work on Saturdays, to earn at least as much as she would delivering papers one hour each day for the Daily Blab? the Early Bird? (Express your answer to the nearest hour.)

b. Decide which newspaper you would like to apply to. Write a paragraph giving at least three reasons for your choice.

Teaching Tips

This problem integrates two strands of the elementary math curriculum with the word processing and spreadsheet applications.
First, introduce the **Paper Packing Penny Pincher** problem to your students (see the "Suggested Activities" section on page 3-77 for some ideas).

Next, have them boot their student data disk and load either one of the following word processing files depending on the way you wish to teach the problem:

PAPERblank
This word processing file contains the Paper Packing Penny Pincher problem and a blank shell of Polya's model. Students type in their own responses.

Having the students use the word processor throughout the problem-solving process provides them with a very powerful tool. Students can quickly get their responses down and then easily revise them later. In addition, the file can be printed out and the clean/readable copy handed in.

If your students do not know how to use the word processing program, provide them with a brief explanation of some of the basic features.

PAPERquestion
This word processing file contains the Paper Packing Penny Pincher problem and Polya's model with a series of prepared questions the students could be asking themselves during the different stages of solving this problem.

Have the students type their responses (in point form) to each step in the model.

During the **Carrying Out the Plan** procedure:
Allow students time to explore the problem by themselves or in groups.
Next introduce the following spreadsheet:

PAPER spreadsheet
- students enter the number of papers into the Number of Papers cells.
- the spreadsheet calculates the total earnings per week, the minutes per day and hours per week.

Understanding the Problem

- What do I want to do?
Help Jan decide to work during the week or on Saturdays only.
Decide which newspaper you would like to apply to.

- What are my choices?
The Daily Blab; the Early Bird; and the Weekender.

- What am I given?
You know she delivers the daily papers one hour per day and the ads give you the per paper earnings and the times to be delivered.

- What am I asked to find?
How long it would take her to deliver the Weekender to earn at least as much as to deliver the daily newspapers for one hour per day (to the nearest hour).

- What am I asked to do?
Decide on a newspaper to apply to and write a paragraph giving at least three reasons for your choice.

Making a Plan

- Can I make a chart?
A chart would help organize the information.

- Can I use guess and check?
Yes, but it would take a lot of guesses and calculations.

- Can I use a computer?
A spreadsheet would be an efficient way to organize the information, manipulate and make changes to the number of papers and analyze the effects on the earnings and delivery time.

- Students should think about a reason for their plan.

Carrying Out the Plan

- What information do I need to organize?
The numbers of newspapers, total earnings and time it takes.

- How can a spreadsheet help me solve the problem?
A spreadsheet would be useful to organize the information in a chart and to do the calculations. The chart allows for quick comparisons of earnings and time, as the number of papers changes.

- What would the spreadsheet look like?
It would show the number of papers, earnings per paper for both the daily and the weekend deliveries, the number of earnings per week and the time it takes in minutes per day and hours per week.

- What will the spreadsheet have to calculate?
The total earnings per week, minutes per day and hours per week.

...using a Spreadsheet

- Use the **PAPER** spreadsheet to help solve the problem.

- Teachers should ask students to think about their plan as they go along and be prepared to explain:
  - *What* exactly they are doing.
  - *Why* they are doing it.
  - *How* it is going to help them solve the problem.

- Students should print a copy of their completed spreadsheet to hand in to the teacher.

Looking Back

(a) • Did I answer the questions asked?
Students should state their final answers in complete sentences: the spreadsheet should show 69 papers or 4 hours with respect to the Daily Blab and 200 papers or 12 hours with respect to the Early Bird.

Students should have written a paragraph to defend their choice of newspaper, including at least three comments about the number of papers they have to deliver, the time they can spend working and the earnings they can make.

• What decisions did I make along the way?
The number of papers to deliver.
To decide on the newspaper to deliver, students will make decisions regarding time of day, hours they can work and earnings they would like to make.

• Are my answers reasonable?
The number of papers and the time it would take to deliver the Weekender.

• Are there other reasonable answers?
All spreadsheets handed in should be the same.

• What happened to the length of time and total earnings when the number of papers was increased? decreased?
They went up when increased, and down when decreased.

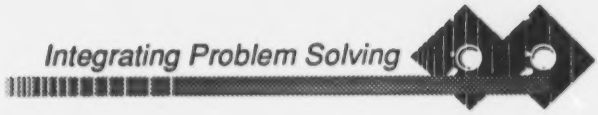
• Compare the minutes per day and the earnings for the Early Bird and the Daily Blab? the Daily Blab and the Weekender?
The times are almost the same (60 - 61 minutes); however, the earnings for the Early Bird are much higher ($66 - $22.56).
The time to deliver the Weekender is much higher (242 minutes compared with 60 minutes).

• Compare the earnings for the two daily papers if there were 30 of each.
The Early Bird is $90 whereas the Daily Blab is much less at $28.20.

• Would it be possible to deliver 60 daily newspapers? Why or why not?
No, because in both cases it would take too long.

• What is the maximum number of papers that Jan could deliver working no longer than 75 minutes on Saturdays? two hours on Saturdays?
Twenty-one papers; 34 papers.

• If Jan wanted to earn at least $25 per week, what is the least number of papers she would have to deliver for the Daily Blab? the Early Bird? The Weekender? Are your answers reasonable?
Twenty-seven for the Daily Blab, nine for the Early Bird and seventy-nine for the Weekender. It is not reasonable to deliver only nine papers.



- How many minutes does it take to deliver one Daily Blab newspaper? one Early Bird? one Weekender? Why do you think they are different?

Daily Blab takes 2.5 minutes, the Early Bird 2.75 minutes, and the Weekender 3.5 minutes.
Answers may vary (weight of paper, time of day, etc.).

- How did the spreadsheet help me solve the problem?

The calculations were done very quickly.
Many different combinations could be analyzed and the most suitable choices made.
The information was organized so it was easy to see and work with.

- How did the spreadsheet calculate the total earnings for each paper?

It multiplied five times the earnings on daily papers and added two times the earnings for weekend papers.

- How did the spreadsheet calculate the number of minutes per day for each paper? Are they the same?

The spreadsheet multiplies the number of papers by the number of minutes needed to deliver each paper.
No (see information at top of the page).

- How did the spreadsheet calculate the hours per week?

The number of minutes per day multiplied by 7 and divided by 60 minutes per hour.

- Could the spreadsheet be set up differently?

Encourage the students to discuss other ways.

- What else could I do with this spreadsheet?

It could be adjusted to fit the number of homes in their neighbourhood and the time it would take to deliver the papers.
It could be adjusted for the number of hours it is possible for them to work (depending on other commitments – homework, sports, music lessons, etc.).
Use it to compare other jobs, earnings and time worked.

- Can I write a different problem that could be solved using this spreadsheet?

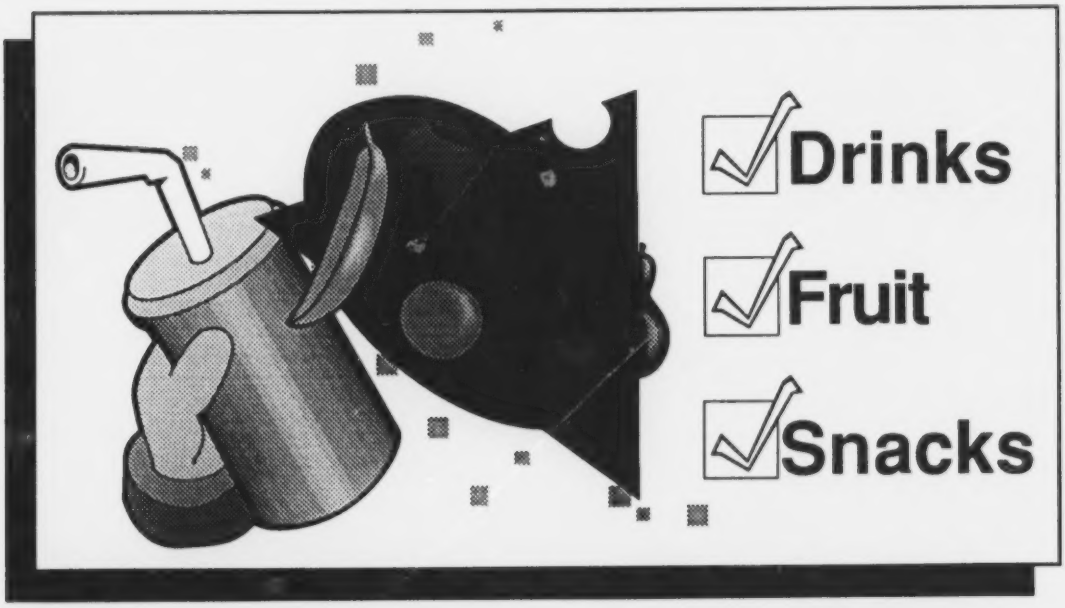
Encourage students to write and solve their own problems.

(b) Decide which newspaper you would like to apply to. Write a paragraph giving at least three reasons for your choice.

Division II
Let's Party

THE PROBLEM

Your class is planning to have a party. Your job is to make a shopping list for the party. The list must include some fruit, a drink and at least one other snack for each person in your class. What would you buy if you had only $28 to spend?



Understanding the Problem

- What is the problem about?
- What are my choices?
- What am I given?
- What am I asked to do?
- What information do I need to know?

Making a Plan

- Can I make an organized list?
- Can I use guess and check?
- Can I make a table?
- Can I use a computer?
- Think about a reason for my plan.

Carrying Out the Plan

- What information do I need to organize?
- How much snack food do I need?
- How many drinks do I need?
- How can a database help me to solve this problem?
- What does the database look like?

...using a database

- I can use the **PARTYdata** database to help me select the different snacks and drinks.

- How can a spreadsheet help me solve the problem?
- What would the spreadsheet look like?
- What will the spreadsheet have to calculate?

...using a spreadsheet

- I can use the **PARTY** spreadsheet to help me solve the problem.

- I need to think about my plan:
  - *What* exactly am I doing?
  - *Why* am I doing it?
  - *How* is it going to help me solve the problem?

...using a word processor

- Print a copy of the shopping lists and completed database and spreadsheet to hand in to the teacher.

Looking Back

- Did I solve the problem?
- What decisions did I make along the way?
- Is the list reasonable?
- Could there be other reasonable lists?
- How many people did I buy for?
- Did I remember to include the teacher?
- What would happen if the principal also came to the party? if three students in the class were sick that day?
- What is the cheapest way to buy drinks?
- How might I give each person a snack, as well as a variety of fruit? more than one drink?
- What happens if I have to buy cups too?
- What information do the stock numbers give me?
- How do stores use this information?
- What do the numbers in the 200s represent? the 400s? the 500s?
- How can the teacher tell if I have fruit and drinks?
- What are the five cheapest foods? the five most expensive foods?
- Name the first five food items in alphabetical order.
- How did the database help me solve this problem?
- What other kinds of information could be included on this database?
- Sort the database to find the number of different kinds of juices; the number of different bakery items.
- How did the spreadsheet help me solve the problem?
- How did the spreadsheet calculate the cost of each item? the total cost?
- Could the spreadsheet be set up differently?
- What else could I do with this spreadsheet?
- Can I write a different problem that could be solved using this spreadsheet?

Division II
Let's Party

TEACHERS' GUIDE

THE PROBLEM

Your class is planning to have a party. Your job is to make a shopping list for the party. The list must include some fruit, a drink and at least one other snack for each person in your class. What would you buy if you had only $28 to spend?

Teaching Tips

This problem integrates three strands (Numeration, Operations and Properties and Graphing) of the elementary math curriculum with the word processing, database and spreadsheet applications.

First, introduce the **Let's Party** problem to your students (see the "Suggested Activities" section on page 3-77 for some ideas).

Next, have them boot their student data disk and load either one of the following word processing files depending on the way you wish to teach the problem.

PARTYblank
This word processing file contains the Let's Party problem and a blank shell of Polya's model. Students type in their own responses.

Having the students use the word processor throughout the problem-solving process provides them with a very powerful tool. Students can quickly get their responses down and then easily revise them later. In addition, the file can be printed out and clean/readable copy handed in.

If your students do not know how to use the *WORKS* word processing program, provide them with a brief explanation of some of the basic features.

PARTYquestion
This word processing file contains the Let's Party problem and Polya's model with a series of prepared questions the students should be asking themselves during the different stages of solving this problem.

Have the students type a short paragraph, in their own words, to address their responses to each step in the model.

During the **Carrying Out the Plan** procedure:
Allow students time to explore the problem by themselves or in groups.

• **Database**
Students should be introduced to the **PARTYdata** database and should know how to:

- find or select certain records
- arrange records

• **Spreadsheet**
Next, introduce the **PARTY** spreadsheet:

- students enter the stock number, food type, quantity and cost per unit into the appropriate cells.
- the spreadsheet calculates the cost of each food item and the total cost.

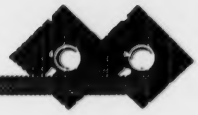
• **Word Processor**
Have students copy the spreadsheet over to the word processor and print their shopping list.

Understanding the Problem

• What is the problem about?
A class party for which I need to arrange snacks and drinks.

• What are my choices?
Fruit, snacks and drinks.

• What am I given?
You can spend $28.



- What am I asked to do?
To make a shopping list for the party.
To include some fruit, a drink and a snack for everyone.

- What information do I need to know?
The number of people in the class.
The cost of the food.

Making a Plan

- Can I make an organized list?
Yes, you need to make a list that includes fruit, snacks and drinks.

- Can I use guess and check?
Yes, but it would take a long time to calculate the costs.

- Can I make a table?
A table would help organize the information.

- Can I use a computer?
Yes, a database and a spreadsheet can be used to organize the information, make quick changes and do the calculations.
A word processor could be used to write up the shopping lists.

- Students should think about a reason for their plan.

Carrying Out the Plan

- What information do I need to organize?
The choice of snacks, their stock numbers, the amount, costs and total cost.

- How much snack food do I need?
Enough for each person and as much as you can afford.

- How many drinks do I need?
At least one per person.

- How can a database help me solve this problem?
The database can be sorted alphabetically and numerically to put the food items, stock numbers or costs in order.

- What does the database look like?
It has the stock number, fruit, snacks and juices as well as their per person costs.

...using a database

- I can use the **PARTYdata** database to help me select the different snacks and drinks.

- How can a spreadsheet help me solve the problem?
The database will help you organize your selections, input the quantity and calculate the costs.

- What would the spreadsheet look like?
It would show the type of snack or juice, their stock number, per person cost, cost of each item and total cost.

- What will the spreadsheet have to calculate?
The cost of each snack or juice type, and the total cost.

...using a spreadsheet

- Use the **PARTY** spreadsheet to help solve the problem.

- Teachers should ask students to think about their plan as they go along and be prepared to explain:
  - *What* exactly they are doing.
  - *Why* they are doing it.
  - *How* it is going to help them solve the problem.

...using a word processor

- Students should print a copy of their shopping lists and completed database and spreadsheet to hand in to the teacher.

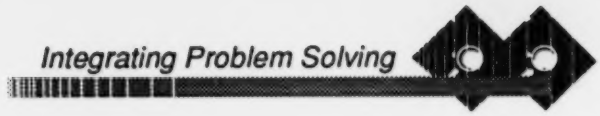
Looking Back

- Did I solve the problem?
Students should write their choices and include the database and spreadsheet with their list.

- What decisions did I make along the way?
The kinds of food, the amounts of each.
The amount of money to spend made certain choices unrealistic so adjustments had to be made.
The number of people who would be at the party.

- Is the list reasonable?
The bottom line should show a total cost less than or equal to $28.

- Could there be other reasonable lists?
Yes, the lists will depend on individual preferences.



- How many people did I buy for?
Answers will depend on the number in the class.

- Did I remember to include the teacher?
Answers will vary.

- What would happen if the principal also came to the party? if three students in the class were sick that day?
More drinks and snacks might be needed.
There would be food left over or some people would have more if others were sick.

- What is the cheapest way to buy drinks?
Buy drink mixes.

- How might I give each person a snack, as well as a variety of fruit? more than one drink?
Cut the fruit into smaller pieces.
Share a can or bottle of pop; use mix drinks and give smaller amounts.

- What happens if I have to buy cups too?
The cost goes up and should be compared with the cost of prepared juices.

- What information do the stock numbers give me?
They tell you the type of snacks: for example, baked goods, candy, fruit and drinks.

- How do stores use this information?
To identify categories of food and the types included in each category.

- What do the numbers in the 200s represent? the 400s? the 500s?
Bakery items; fruit; drinks.

- How can the teacher tell if I have fruit and drinks?
By checking the spreadsheet to make sure there were 400s for fruit and 500s for drinks.

- What are the five cheapest foods? the five most expensive foods?
Peppermint sticks, suckers, bananas, cookies, oranges and apples.
Peanuts, chocolate bars, taco chips, cheesies and potato chips.

- Name the first five food items in alphabetical order.
Apples, bananas, bottled juice, bottled pop and brownies.

- How did the database help me solve this problem?
It allowed information to be easily found, organized and sorted .

- What other kinds of information could be included on this database?
Encourage students to discuss such things as name, address and phone numbers of suppliers; quantities ordered; inventory.

- Sort the database to find the number of different kinds of juices; the number of different bakery items.

Seven juices; four bakery items.

- How did the spreadsheet help me solve the problem?

The costs and total cost were calculated very quickly.
Different combinations were analyzed and adjustments to quantity and costs made easily and quickly.

- How did the spreadsheet calculate the cost of each item? the total cost?

The spreadsheet multiplies the cost of one item by the number (amount) of items.
Total cost is found by adding cost column.

- Could the spreadsheet be set up differently?

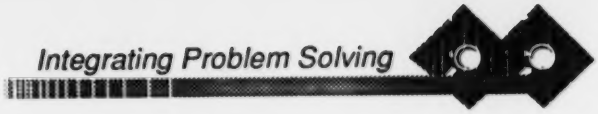
Encourage students to discuss different ways.

- What else could I do with this spreadsheet?

It could be used to make other shopping lists.

- Can I write a different problem that could be solved using this spreadsheet?

Encourage students to write and solve their own problems.

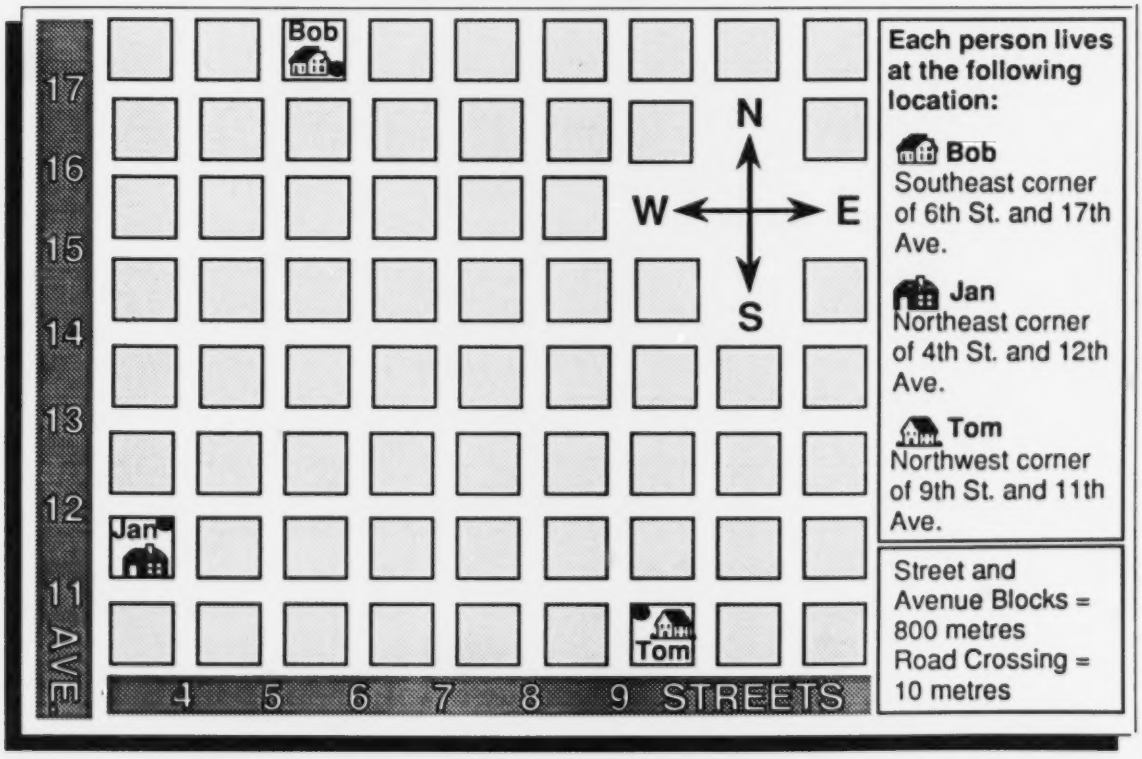


Part A
Section 2
Elementary Math Problems

Division II
The Club Has Arrived

THE PROBLEM

Bob, Jan and Tom are members of a neighbourhood club. They are planning to meet at the corner of a block to discuss club business. Tom has recently broken his leg and has some difficulty walking. Find the exact street and avenue for a meeting so that Tom does not have to walk more than 14 minutes and the other two members walk no more than 22 minutes. What is the total distance travelled by each member?



Division II
The Club Has Arrived

TEACHERS' GUIDE

THE PROBLEM

Bob, Jan and Tom are members of a neighbourhood club. They are planning to meet at the corner of a block to discuss club business. Tom has recently broken his leg and has some difficulty walking. Find the exact street and avenue for a meeting so that Tom does not have to walk more than 14 minutes and the other two members walk no more than 22 minutes. What is the total distance travelled by each member?

Teaching Tips

This problem integrates three strands of the elementary math curriculum with the word processing and spreadsheet applications of *WORKS*.
First, introduce the **The Club Has Arrived** problem to your students using Polya's model. There are several ways of doing this. The method you choose should be based on your own teaching style and the problem-solving skill level of your students (see the "Suggested Activities" section on page 3-77 for some ideas).

The following files are contained on the student disk:

• **CLUBblank** (word processing file)
This word processing file contains the The Club Has Arrived problem and a blank shell of Polya's model. Students type in their own responses. Also, a master, blank copy of Polya's model is included in Appendix H.

• **CLUB** (spreadsheet)
- Students enter the number of street blocks, avenue blocks and road crossings for each club member.

- The total number of blocks, distance travelled and time taken are calculated automatically.

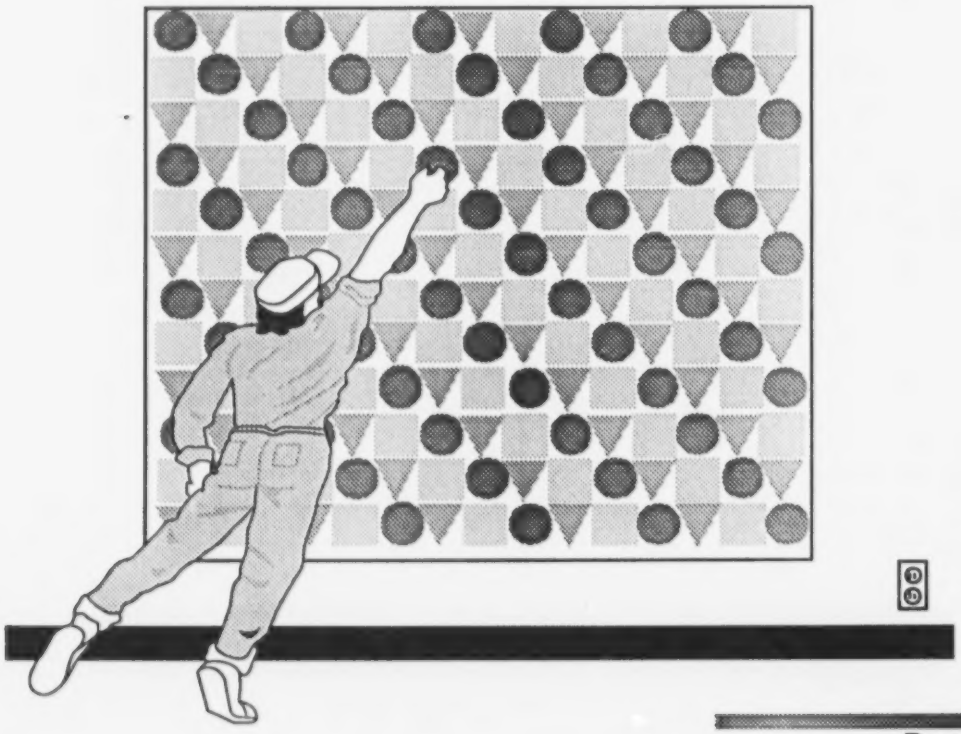
- The time it takes each club member to walk one block can be seen by entering 1 in the street or avenue block cells.

- The time it takes each club member to walk across a street can be seen by entering 1 in the road crossing cells.

Division II
Shaping Up With Clay

THE PROBLEM

Your class is involved in an art project. The project is to decorate an 8 m by 8 m wall using clay shapes that have a height and width of 8 cm. You need to cover the wall using three different shapes: triangles, squares and circles. The shapes are to be arranged side by side, touching each other. There are 5 kg of clay available for the project. You need 64 g of clay to make one square shape, 32 g to make a triangle and 50 g for a circle. Using no more than 40% of each shape, and as much clay as possible, find the number of circles, triangles and squares you will need for your design.



Division II
Shaping Up With Clay

TEACHERS' GUIDE

THE PROBLEM

Your class is involved in an art project. The project is to decorate an 8 m by 8 m wall using clay shapes that have a height and width of 8 cm. You need to cover the wall using three different shapes: triangles, squares and circles. The shapes are to be arranged side by side, touching each other. There are 5 kg of clay available for the project. You need 64 g of clay to make one square shape, 32 g to make a triangle and 50 g for a circle. Using no more than 40% of each shape, and as much clay as possible, find the number of circles, triangles and squares you will need for your design.

Teaching Tips

This problem integrates three strands of the elementary math curriculum with the word processing and spreadsheet applications.

First, introduce the **Shaping Up With Clay** problem to your students using Polya's model. There are several ways of doing this. The method you choose should be based on your own teaching style and the problem-solving skill level of your students (see the "Suggested Activities" section on page 3-77 for some ideas).

The following files are contained on the student disk:

• **CLAYblank** (word processing file)
This word processing file contains the Shaping Up With Clay problem and a blank shell of Polya's model. Students type in their own responses. Also, a master, blank copy of Polya's model is included in Appendix H.

• **CLAY** (spreadsheet)
- Students enter the number of objects (circles, squares and triangles) they will need for their design.
- Area and percentage of wall covered and the amount of clay needed for each object is calculated automatically.
- Total area covered by all objects and the total amount of clay used is calculated automatically.

Division II
Subject Survey

THE PROBLEM

Your class is going to do a survey of the most popular subjects in your school. Your teacher is then going to have you construct graphs to show: (a) the three most popular subjects; (b) the popularity of subjects by each grade; (c) the three most popular subjects among girls and boys.

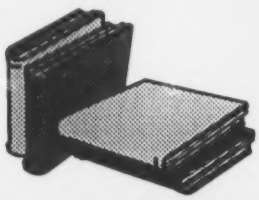
OUR OWN SCHOOL SUBJECT SURVEY

Name:_____

Gender: _____ Grade: _____

Favourite Subject: _____

Thanks for helping us with our survey!



Division II
Subject Survey

TEACHERS' GUIDE

THE PROBLEM

Your class is going to do a survey of the most popular subjects in your school. Your teacher is then going to have you construct graphs to show: (a) the three most popular subjects; (b) the popularity of subjects by each grade; (c) the three most popular subjects among girls and boys.

Teaching Tips

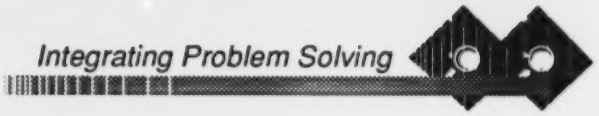
This problem integrates four strands of the elementary math curriculum with the word processing and database applications.

First, introduce the **Subject Survey** problem to your students using Polya's model. There are several ways of doing this. The method you choose should be based on your own teaching style and the problem-solving skill level of your students (see the "Suggested Activities" section on page 3-77 for some ideas).

The following files are contained on the student disk:

• **SUBJECTblank** (word processing file)
This word processing file contains the Subject Survey problem and a blank shell of Polya's model. Students type in their own responses. Also, a master, blank copy of Polya's model is included in Appendix H.

• **SUBJECTdata** (database)
- Students can survey the school using a simple survey form.
- Collected data are entered into the database.
- The find and sort features of the database are used to solve the problem.

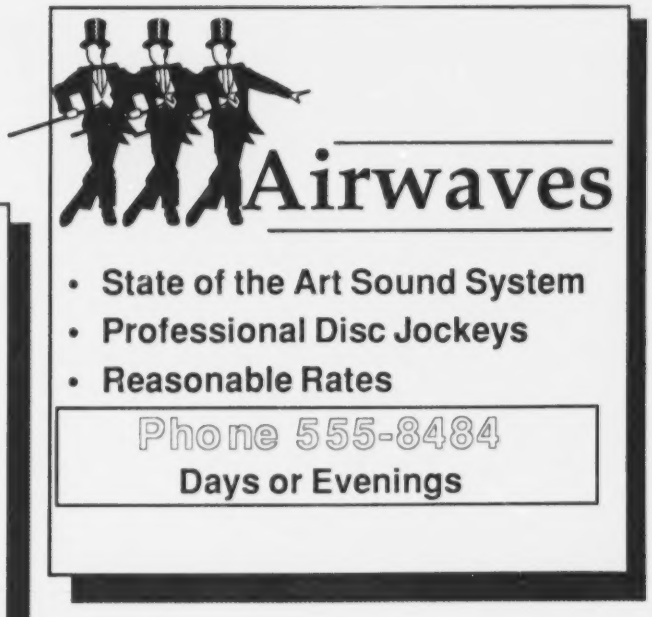


Part B
Section 1
Junior High Math Problems

Division III
Dance For Donations

THE PROBLEM

Your student council is planning a dance. They hope to have as many of their 154 students as possible come to the dance so they can raise $125 for the Food Bank. Their only cost is the disc jockey's salary. They can hire "Airwaves" for $150, or "Cool Tunes" for $200, which includes a light show. What is the lowest price they can charge for each dance ticket in order to cover costs and collect the money for the Food Bank?



Understanding the Problem

- What is being planned?
- How many students *could* attend?
- Why are the students having the dance?
- How much money do they want to raise?
- Where is the money going to come from?
- What am I being asked to find?

...and, Getting Started

- What information do I need before I can solve the problem?
- How is the information related?
- How can I organize the information?
- What do I need to do first?

Making a Plan

- Can I use trial and error?
- Can I make a table or chart?
- Can I use a computer?
- Think about a reason for my plan.

Carrying Out the Plan

- How can a spreadsheet help me solve the problem?
- What would the spreadsheet look like?
- What will the spreadsheet calculate?

...using a Spreadsheet

- I can use the **DANCE** spreadsheet to help me solve the problem.
- I need to think about my plan:
    - *What* exactly am I doing?
    - *Why* am I doing it?
    - *How* is it going to help me solve the problem?
- Print a copy of the completed spreadsheet to hand in to the teacher.

- How did I estimate the number of students who would attend?
- Did I answer the question asked?
- What decisions or assumptions did I make along the way?
- Is my answer reasonable?
- Are there other reasonable answers?

...and, Extending the Problem

- How was it possible to charge less for a ticket?
- What happened to the ticket cost when I paid $200 for the disc jockey compared to $150?
- What happened to the income when I estimated that more students would attend?
- What could I do to get more students to attend?
- How many students would have to attend if I charged $3.75 a ticket and went with the lower priced DJ? $4 a ticket? $5.25 a ticket?
- What price would I have to charge if 98 students attended and I had a light show? 105 students? 84 students?
- How did the spreadsheet help me solve the problem?
- Could the spreadsheet be set up differently?
- What else could I do with this spreadsheet?
- Can I write a different problem that could be solved using this spreadsheet?

Division III
Dance For Donations

TEACHERS' GUIDE

THE PROBLEM

Your student council is planning a dance. They hope to have as many of their 154 students as possible come to the dance so they can raise $125 for the Food Bank. Their only cost is the disc jockey's salary. They can hire "Airwaves" for $150, or "Cool Tunes" for $200, which includes a light show. What is the lowest price they can charge for each dance ticket in order to cover costs and collect the money for the Food Bank?

Teaching Tips

This problem integrates three strands of the junior high math curriculum with the spreadsheet.
First, introduce the **Dance For Donations** problem to your students using Polya's model.There are several ways of doing this. The method you choose should be based on your own teaching style and the problem-solving skill level of your students (see the "Suggested Activities" section on page 3-77 for some ideas).

In Appendix H there is a blank shell of Polya's model that can be duplicated and handed out to your students. They can write their responses directly on this sheet.

If your students require more assistance in solving the problem, you may wish to provide them with the student master sheet that contains a series of prepared questions to help them write their responses under each step of Polya's model.

During the **Carrying Out the Plan** procedure introduce the **DANCE** spreadsheet.

- students enter information into the Students, Ticket Price and D.J. cells of the spreadsheet. The spreadsheet will automatically calculate the Costs and Income.
- students should use the spreadsheet like a table or a chart to compare the differences that occur when various options are chosen.

Understanding the Problem

- What is being planned?

A dance.

- How many students *could* attend?

Up to 154.

- Why are the students having the dance?

To raise money for the Food Bank.

- How much money do they want to raise?

Enough to cover the disc jockey and $125 for the Food Bank.

- Where is the money going to come from?

The ticket sales.

- What am I being asked to find?

The lowest price the student council can charge for a ticket to the dance and still cover costs.

...and, Getting Started

- What information do I need before I can solve the problem?

A realistic estimate of the number of students who would attend the dance.
A range of prices they would pay.
What kind of DJ to hire.

- How is the information related?

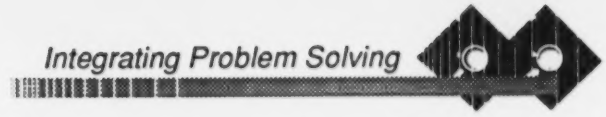
The more students who attend, the less the tickets will cost.
The higher the ticket cost, the fewer the number of students who will attend.
The more expensive DJ may attract more students.

- How can I organize the information?

Make a chart or table with different numbers of students, ticket prices and DJs.
Use trial and error to check many different combinations, until you find one that seems to give the lowest price for a ticket.

- What do I need to do first?

Decide on the kind of music.
Estimate the number of students.
Decide on a ticket.



Making a Plan

- Can I use trial and error?
You could, but it would take a long time to test all the different combinations.

- Can I make a table or chart?
A chart would help organize all the information.

- Can I use a computer?
A spreadsheet would be an efficient way to organize the information, manipulate and make changes in one thing at a time, and analyze the effects on the cost of the tickets.

- Students should think about a reason for their plan.

Carrying Out the Plan

- How can a spreadsheet help me solve the problem?
*The **DANCE** spreadsheet will help you make changes in numbers of students, costs of tickets and choice of DJ and do quick calculations for you.*

- What would the spreadsheet look like?
It will show the number of students, the ticket price, cost of the DJ, the profit and all the calculations necessary.

- What will the spreadsheet calculate?
The total income, the amount of money needed to cover costs plus DJ and the total profit.

...using a Spreadsheet

- Use the **DANCE** spreadsheet to solve the problem.

- Teachers should ask students to think about their plan as they go along and be prepared to explain:

  - *What* exactly they are doing.
  - *Why* they are doing it.
  - *How* it is going to help them solve the problem.

- Students should print a copy of their completed spreadsheet to hand in to the teacher.

Looking Back

- How did I estimate the number of students who would attend?

The number of students in the school, previous dances, popularity of the DJ.

- Did I answer the question asked?

Students should state their final answers in complete sentences: the lowest price they should charge for a dance ticket.

- What decisions or assumptions did I make along the way?

How they estimated the number of students who would attend; how they decided on ticket prices; how they decided on a DJ .

- Is my answer reasonable?

The cost of the dance ticket and your estimate of the number of students who would attend.

- Are there other reasonable answers?

There will be a range of reasonable answers.
Students can discuss the range.

...and, Extending the Problem

- How was it possible to charge less for a ticket?

If more students attended; if the cheaper DJ was chosen; if less is given to the Food Bank.

- What happened to the ticket cost when I paid $200 for the disc jockey compared with $150?

It went down.

- What happened to the income when I estimated that more students would attend?

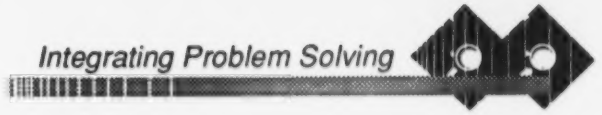
It was higher.

- What could I do to get more students to attend?

Lower the ticket price.
Hire a more popular DJ.
Offer door prizes.
Advertise .
Allow students to bring food to donate to the Food Bank instead of raising money.

- How many students would have to attend if I charged $3.75 a ticket and went with the lower-priced DJ? $4 a ticket? $5.25 a ticket?

Seventy-four students; 69 students; 53 students.



- What price would I have to charge if 98 students attended and I had a light show? 105 students? 84 students?

$3.32 a ticket; $3.10 a ticket; $3.87 a ticket.

- How did the spreadsheet help me solve the problem?

The calculations were done quickly.
Many different combinations could be analyzed and the most suitable choices made.
The information was organized so it was easy to see and work with.

- Could the spreadsheet be set up differently?

Encourage students to discuss other ways.

- What else could I do with this spreadsheet?

You can look for the lowest price of each ticket to charge when your costs are higher.
You could calculate costs per student for any number of different activities (for example, drama performances).
You could find the highest price it is reasonable to charge in order to make a profit.

- Can I write a different problem that could be solved using this spreadsheet?

Encourage students to write and solve their own problems.

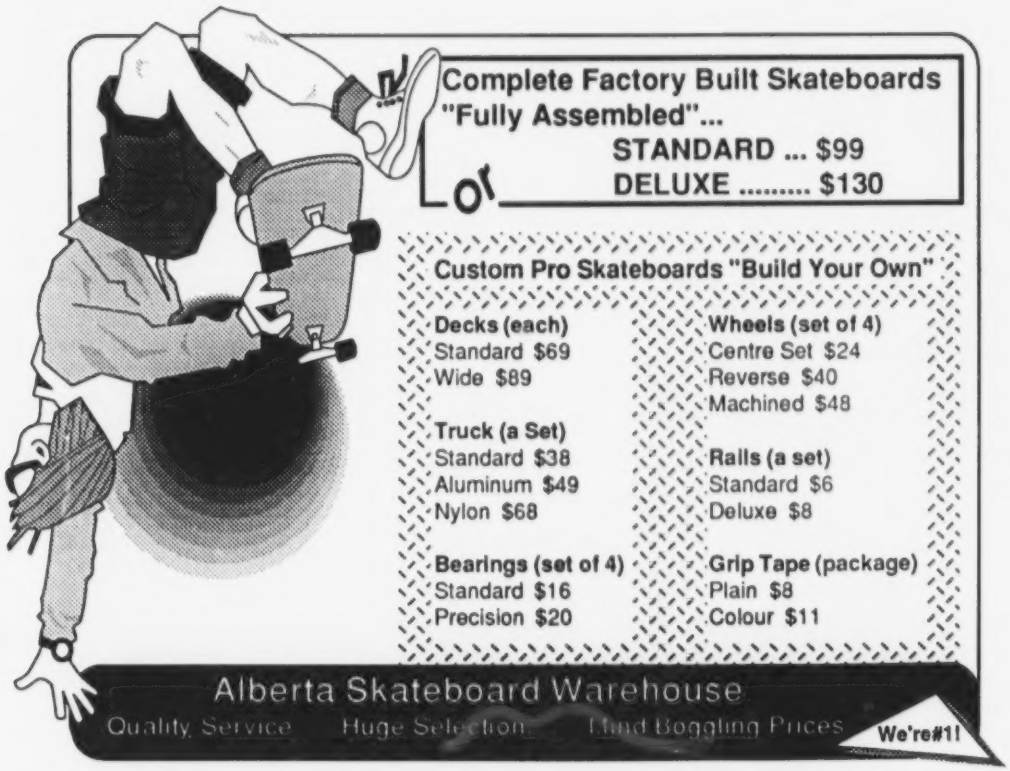
Division III
Super Skateboard Shopper

THE PROBLEM

You would like to buy a skateboard. You can build your own custom pro skateboard, or you can buy one that is factory built. You receive an allowance of $10 a week to spend on treats and to save for special things. In addition to this, you can earn $5 an hour doing odd jobs around your neighbourhood.

a. Using the ad below, choose both a factory built and a custom pro skateboard that you would like to purchase.

b. How could you save enough money to purchase one of the skateboards that you have selected in part a. of this problem in 10 weeks? 15 weeks? 20 weeks?



Understanding the Problem

- What do I want to buy?
- What kind can I buy?
- Where can I get the money?
- What is the purpose of my allowance?
- What am I being asked to find?

...and, Getting Started

- What information do I need before I can solve the problem?
- How is the information related?
- What do I need to do first?
- How can I organize the information?

Making a Plan

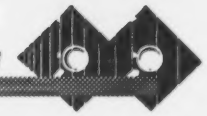
- Can I use trial and error?
- Can I make an organized list?
- Can I make a table or chart?
- Can I use a computer?

Carrying Out the Plan

- How can spreadsheets help me solve both parts of the problem?
- What would the spreadsheets look like?
- What do I need to calculate?
- What information do I need to organize for part a.? part b.?

...using a Spreadsheet

- I can use the **SKATEcost** spreadsheet to help me decide on two different skateboards.
- I need to think about my plan:
  - *What* exactly am I doing?
  - *Why* am I doing it?
  - *How* is it going to help me solve the problem?
- Print a copy of the completed spreadsheet to hand in to the teacher.



- I can use the **SKATEtime** spreadsheet to do the calculations for the different number of weeks.

    - I need to think about my plan:
        - *What* exactly am I doing?
        - *Why* am I doing it?
        - *How* is it going to help me solve the problem?

- Print a copy of the completed spreadsheet to hand in to the teacher.

Looking Back

- Did I answer the questions asked?
- What decisions or assumptions did I make along the way?
- Are my answers reasonable?
- Are there other reasonable answers?

...and, Extending the Problem

- What did I do to shorten the period? to lengthen it?
- What happened when I spent more of my allowance on treats?
- How did the cost of a custom pro board compare to that of the factory built board?
- How did the spreadsheets help me solve the problem?
- Could the spreadsheets be set up differently?
- What else could I do with these spreadsheets?
- Can I write a different problem that could be solved using these spreadsheets?

Division III
Super Skateboard Shopper

TEACHERS' GUIDE

THE PROBLEM

You would like to buy a skateboard. You can build your own custom pro skateboard, or you can buy one that is factory built. You receive an allowance of $10 a week to spend on treats and to save for special things. In addition to this, you can earn $5 an hour doing odd jobs around your neighbourhood.

a. Using the ad below, choose both a factory built and a custom pro skateboard that you would like to purchase.

b. How could you save enough money to purchase one of the skateboards that you have selected in part a. of this problem in 10 weeks? 15 weeks? 20 weeks?

Teaching Tips

This problem integrates four strands of the junior high math curriculum with the word processing and spreadsheet applications.

First, introduce the **Super Skateboard Shopper** problem to your students (see the "Suggested Activities" section on page 3-77 for some ideas).

Next, have them boot their student data disk and load either one of the following word processing files depending on the way you wish to teach the problem.

SKATEblank
This word processing file contains the Super Skateboard Shopper problem and a blank shell of Polya's model. Students type in their own responses.

Having the students use the word processor throughout the problem-solving process provides them with a very powerful tool. Students can quickly get their responses down and then easily revise them later. In addition, the file can be printed out and clean/readable copy handed in.

If your students do not know how to use the word processing program, provide them with a brief explanation of some of the basic features.

SKATEquestion
This word processing file contains the Super Skateboard Shopper problem and Polya's model with a series of prepared questions the students should be asking themselves during the different stages of solving this problem.

Have the students type a short paragraph, in their own words, to address their responses to each step in the model.

During the **Carrying Out the Plan** procedure:
Allow students time to explore the problem by themselves or in groups.
Next introduce the following spreadsheets:

SKATEcost spreadsheet
- this spreadsheet allows students to select their two skateboards.

SKATEtime spreadsheet
- students enter the cost of each skateboard into the Cost cells.
- students enter the hours they wish to work into the Hours/Job cells.
- students enter the amount of money they wish to spend on treats into the Treats cells.
- the spreadsheet calculates the earnings for working, the amount saved and the number of weeks it will take to purchase each skateboard.

Understanding the Problem

- What do I want to buy?
A skateboard.

- What kind can I buy?
One that is factory built or a custom pro board.

- Where can I get the money?
From the allowance and/or from odd jobs.

- What is the purpose of my allowance?
To buy treats and to save for special things.

- What am I being asked to find?
Two kinds of skateboards and how to save money to purchase the preferred board in 10, 15 and 20 weeks.

...and, Getting Started

- What information do I need before I can solve the problem?
Which factory skateboard to choose.
The options desired for a custom pro board.
The cost of the preferred board.
How much of the allowance will be saved.
Whether to work at odd jobs.
How much time it is reasonable to work.

- How is the information related?
The type of board will determine the cost.
The reasonableness of the cost may determine the board chosen.
The amount saved from the allowance will determine the length of time it takes to purchase the board and whether you need to work at odd jobs.
The amount of the allowance needed for treats each week determines the amount that can be saved.
The period determines whether to work at odd jobs; so does the skateboard chosen.
The amount of extra time to spend working will determine how quickly the money can be saved.

- What do I need to do first?
Decide what kind of board before determining the cost and length of time to save.
Decide how much to save from the allowance and whether or not you need to work.

- How can I organize the information?

Make a list of the options chosen.
Calculate the costs with several different options until you find the one you want to choose.
Make a chart or table with allowance, money spent on treats and money saved from allowance as well as number of hours worked, money earned and the total amount saved.
Make a list of the cost, amount saved and calculated number of weeks.
Try many different calculations, until the number of weeks corresponds to what the question is asking.

Making a Plan

- Can I use trial and error?

You could, but it would take a long time to do the calculations.

- Can I make an organized list?

It would be harder to change options and costs.

- Can I make a table or chart?

A chart would be helpful to organize and keep track of options.

- Can I use a computer?

A spreadsheet would be an efficient way to organize the information, manipulate and make changes in one thing at a time, and analyze the effects on the number of weeks.

Carrying Out the Plan

- How can spreadsheets help me solve both parts of the problem?

*The **SKATEcost** spreadsheet will help you choose a custom built board and quickly calculate the cost .*
*The **SKATEtime** spreadsheet will help you calculate the number of weeks using different combinations of allowance saved and money earned from odd jobs.*

- What would the spreadsheets look like?

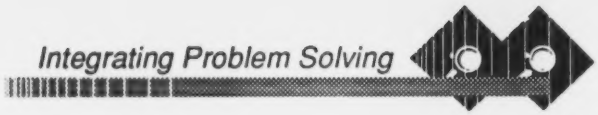
*The **SKATEcost** spreadsheet will contain all of the options, their costs and the total cost of the boards.*
*The **SKATEtime** spreadsheet will have the amounts spent on treats, money earned at odd jobs and total amount saved.*

- What do I need to calculate?

The cost of the custom pro skateboard, the total amount saved and the number of weeks it will take to save enough for the skateboard.

- What information do I need to organize for part a.? part b.?

a. The options chosen.
b. The allowance saved and the number of hours to work at odd jobs.



...using a Spreadsheet

- Use the **SKATEcost** spreadsheet to help decide on two different skateboards.
    - Teachers should ask students periodically to explain:
        - *What* exactly they are doing.
        - *Why* they are doing it.
        - *How* it is going to help them solve the problem.
    - Students should print a copy of their completed spreadsheet to hand in.
- Use the **SKATEtime** spreadsheet to do the calculations for the different number of weeks.
    - Again, check to ensure students are on the right track by asking them these key questions:
        - *What* exactly they are doing.
        - *Why* they are doing it.
        - *How* it is going to help them solve the problem.
    - Students should print a copy of their completed spreadsheet to hand in.

Looking Back

- Did I answer the questions asked?

Students should state their final answers in complete sentences:

a. Describe their custom pro board and state which factory built board they selected.

b. Explain how they have decided to save enough money: how much allowance they spent on treats and whether they worked at odd jobs.

- What decisions or assumptions did I make along the way?

Students should state any important assumptions or decisions they made that helped them answer the questions; for example, how they chose their custom and factory built boards, specific information about how much they could save each week, and whether they had chosen to work or not.

- Are my answers reasonable?

The cost of the skateboard, the amount saved from the allowance and the numbers of hours worked each week.

• Are there other reasonable answers?
Yes, depending on hours of work and amount saved.

...and, Extending the Problem

• What did I do to shorten the period? to lengthen it?
Shorten: spent less on treats, worked extra hours.
Lengthen: spent more on treats, chose not to work.

• What happened when I spent more of my allowance on treats?
Less money was saved; the number of weeks could have increased; the hours worked could have increased.

• How did the cost of a custom pro board compare with that of the factory built skateboard?
Answers will vary; for example, the custom pro board may have been more expensive because more high quality options were selected.

• How did the spreadsheets help me solve the problem?
The calculations were done very quickly.
Many different combinations could be analyzed and the most suitable choices made.
The information was organized so it was easy to see and work with.

• Could the spreadsheets be set up differently?
Encourage the students to discuss other ways.

• What else could I do with these spreadsheets?
Use it for other things the students may want to save for.
Allow individual students to input their own allowance.
Allow individual students to input the amount of money they earn at odd jobs.
Allow students to determine how soon they want to make their purchase.

• Can I write a different problem that could be solved using these spreadsheets?
Encourage students to write and solve their own problems.

Division III
Happy Trails to You

THE PROBLEM

Your class is going on a day-trip to the mountains. There are 32 people including the teacher and parent chaperones. Your group is responsible for preparing a trail mix of dried fruit, nuts, crackers and candy. Your budget is $35. To get the best buy for the money, you suggest buying from the Bulk Food Barn.

Write out your shopping list. Remember to order enough so that:
a. each person has at least 165 g;
b. there is a variety of each food type;
c. there is no more than 25% of any one food type.

The
Bulk Food Barn

12 Locations to Better Serve Alberta

Stock #	Food Type	Price Per 100g
100	Peanuts - roasted	$0.50
101	Peanuts - B.B.Q.	$0.50
103	Walnuts	$0.85
108	Pistachio - red	$1.29
109	Pistachio - white	$1.29
110	Peanuts in a shell	$0.36
201	Apples	$0.79
203	Banana chips	$0.39

Stock #	Food Type	Price Per 100g
205	Raisins - sultana	$0.29
206	Raisins - chocolate	$0.88
300	Orange slices	$0.89
302	Ju jubes	$0.49
304	Licorice nibs	$0.49
310	Chocolate chips	$0.69
400	Crackers - rice	$0.89
402	Mixed crackers	$1.03

Shop early for the best selection! • ALL locations open 7 days a week from 9 am - 9 pm

Understanding the Problem

- What do I want to do?
- What are my choices?
- What am I given?
- What am I asked to do?

Making a Plan

- Can I make an organized list?
- Can I use guess and check?
- Can I make a table?
- Can I use a computer?
- Think about a reason for my plan.

Carrying Out the Plan

- What information do I need to organize?
- How many grams of food do I need?
- How can a database help me solve this problem?
- What does the database look like?

...using a database

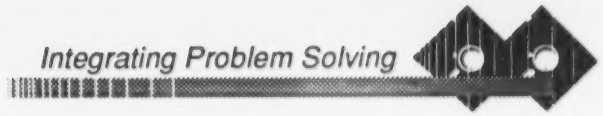
- I can use the **HAPPYdata** database to help me select the different food types.
- How can a spreadsheet help me solve the problem?
- What would the spreadsheet look like?
- What will the spreadsheet have to calculate?

...using a spreadsheet

- I can use the **HAPPY** spreadsheet to help me solve the problem.
- I need to think about my plan:
  - *What* exactly am I doing?
  - *Why* am I doing it?
  - *How* is it going to help me solve the problem?

...using a word processor

- Copy the spreadsheet over to the word processor and print a copy of the completed shopping list to hand in to the teacher.



Looking Back

- Did I solve and write an answer to the problem?
- What decisions did I make along the way?
- Is my shopping list reasonable?
- Are there other reasonable lists?
- How are the stock numbers used in this problem? How do you think stores use this information?
- What do the numbers in the 300s represent? the 400s?
- What information does the percent column give?
- How is it calculated?
- What happened to the numbers in the percent column as more items were included on the list?
- What is an estimate of the sum of the values in the percent column? Will it always be the same? Explain why it may vary.
- How did the database help me solve this problem?
- What are the six cheapest foods? most expensive foods?
- Name the first five food items in alphabetical order.
- What other kinds of information could be included on this database?
- Sort the database to find the number of dried fruit items; the number of crackers.
- How did the spreadsheet help me solve the problem?
- How did the spreadsheet calculate the total number of grams? the total cost?
- Could the spreadsheet be set up differently?
- What else could I do with this spreadsheet?
- Can I write a different problem that could be solved using this spreadsheet?

Division III
Happy Trails to You

TEACHERS' GUIDE

THE PROBLEM

Your class is going on a day-trip to the mountains. There are 32 people including the teacher and parent chaperones. Your group is responsible for preparing a trail mix of dried fruit, nuts, crackers and candy. Your budget is $35. To get the best buy for the money, you suggest buying from the Bulk Food Barn.

Write out your shopping list. Remember to order enough so that:
a. each person has at least 165 g;
b. there is a variety of each food type;
c. there is no more than 25% of any one food type.

Teaching Tips

This problem integrates four strands of the junior high math curriculum with the word processing, database and spreadsheet applications.

First, introduce the **Happy Trails To You** problem to your students (see the "Suggested Activities" section on page 3-77 for some ideas).

Next, have them boot their student data disk and load either one of the following word processing files depending on the way you wish to teach the problem.

HAPPYblank
This word processing file contains the Happy Trails To You problem and a blank shell of Polya's model. Students type in their own responses.

Having the students use the word processor throughout the problem-solving process provides them with a very powerful tool. Students can quickly get their responses down and then easily revise them later. In addition, the file can be printed out and clean/readable copy handed in.

If your students do not know how to use the word processing program, provide them with a brief explanation of some of the basic features.

HAPPYquestion
This word processing file contains the Happy Trails To You problem and Polya's model with a series of prepared questions the students should be asking themselves during the different stages of solving this problem.

Have the students type a short paragraph, in their own words, to address their responses to each step in the model.

During the **Carrying Out the Plan** procedure:
Allow students time to explore the problem by themselves or in groups.

• **Database**
Students should be introduced to the **HAPPYdata** database and should know how to:

- find or select certain records.
- arrange records.

• **Spreadsheet**
Next, introduce the **HAPPY** spreadsheet:

- students enter the stock number, food type, quantity and cost per unit into the appropriate cells.
- the spreadsheet calculates the total number of grams, total cost and percent of each food type and the total cost of the mixture.

• **Word Processor**
Have students copy the spreadsheet over to the word processor and print their shopping list.

Understanding the Problem

- What do I want to do?
Write out a shopping list for the trail mix.

- What are my choices?
Dried fruit, nuts, crackers and candy.

- What am I given?
$35 to spend.

- What am I asked to do?
Order enough so that each person has about 165 g and a variety from the four food types.
Make a shopping list including no more than 25% of each food.

Making a Plan

- Can I make an organized list?
Yes, you need to select and make a list including some of each of the four food types.

- Can I use guess and check?
Yes, but it would take a long time to calculate the total grams and cost.

- Can I make a table?
A table would help organize the information.

- Can I use a computer?
Yes, a database and a spreadsheet can be used to organize the information, make quick changes and do the calculations.
A word processor could be used to write the shopping list.

- Students should think about a reason for their plan.

Carrying Out the Plan

- What information do I need to organize?
The choice of food types, their stock numbers, quantity and costs.

- How many grams of food do I need?
5,280 g.

- How can a database help me solve this problem?

The database can be sorted alphabetically and numerically to put the food items, stock numbers or costs in order; it can arrange the unit costs in order; it can search for selected items; and it can present the data in an organized way.

- What does the database look like?

It has the stock number, different food types and price per 100 g.

...using a database

- You can use the **HAPPYdata** database to help you select the different food types.

- How can a spreadsheet help me solve the problem?

The spreadsheet will help you organize your selections, input the quantity, calculate the costs and the total number of grams; it will also give the percentages of each food in the mixture.

- What would the spreadsheet look like?

It will show the type of food, quantity of each, per unit cost, total number of grams, total cost and percent of mixture.

- What will the spreadsheet have to calculate?

The total number of grams, total cost and percent of each food type, the total cost of the mixture.

...using a spreadsheet

- You can use the **HAPPY** spreadsheet to help you solve the problem.
- Teachers should ask students periodically to explain:
  - *What* exactly they are doing.
  - *Why* they are doing it.
  - *How* it is going to help them solve the problem.

...using a word processor

- Have students copy the spreadsheet over to the word processor and print their shopping list to hand in to the teacher.

Looking Back

- Did I solve and write an answer to the problem?

Students should write their choices and include the spreadsheet for their shopping list.

- What decisions did I make along the way?

The kinds of food wanted, the quantity of each kind.
The final decision was arrived at after a number of adjustments to the quantity of each.

- Is my shopping list reasonable?

The bottom line should show a cost less than or equal to $35 and at least 5,280 g of mixture.

- Are there other reasonable lists?

The lists should vary.

- How are the stock numbers used in this problem? How do you think stores use this information?

To organize and keep track of each type of food.
For inventory control.

- What do the numbers in the 300s represent? the 400s?

The 300s represent candy and the 400s are crackers.

- What information does the percent column give?

The percent of each food type in the total mixture.

- How is it calculated?

By dividing the quantity by the total number of grams.

- What happened to the numbers in the percent column as more items were included on the list?

They were lowered.

- What is an estimate of the sum of the values in the percent column? Will it always be the same? Explain why it may vary.

100%.
No, it could vary between 99% and 101%.
The individual percentages are rounded to the nearest whole number.

- How did the database help me solve this problem?

It allowed information to be easily found, sorted and organized.

- What are the six cheapest foods? most expensive foods?

Sultana raisins, peanuts in the shell, banana chips, peanuts - roasted, Ju jubes and licorice nibs.
Red pistachios, white pistachios, mixed crackers, rice crackers, orange slices and chocolate raisins.

- Name the first five food items in alphabetical order.
Apples, banana chips, chocolate chips, crackers - rice and Ju jubes.

- What other kinds of information could be included on this database?
Encourage discussion of such things as the name, address and phone number of the producer; the quantity ordered; inventory.

- Sort the database to find the number of dried fruit items; the number of crackers.
All four of the 200 numbers.
The two 400 numbers.

- How did the spreadsheet help me solve the problem?
The percentages and totals were calculated very quickly.
Many different combinations could be analyzed and adjustments to quantity and percentages made easily and quickly.

- How did the spreadsheet calculate the total number of grams? the total cost?
By adding the column of quantities.
By adding the column of costs.

- Could the spreadsheet be set up differently?
Encourage students to discuss different ways.

- What else could I do with this spreadsheet?
It could be used for other shopping lists.

- Can I write a different problem that could be solved using this spreadsheet?
Encourage students to write and solve their own problems.

Part B
Section 2
Junior High Math Problems

Division III
A Frame-Up

THE PROBLEM

Sally is designing a bulletin board for her room. She wants to make it large enough to hold a poster, a calendar and her timetable, as well as have extra space for odds and ends. The cork board material she is going to use costs $25.00 per square metre She has saved $23.80 to spend.

a. Select one item from each list in the chart below to help Sally design a rectangle shaped bulletin board. Design a bulletin board which has: (i) 40% free space; (ii) 50% free space; and, (iii) 60% free space. Draw your design and state the dimensions for each bulletin board, as well as its cost.

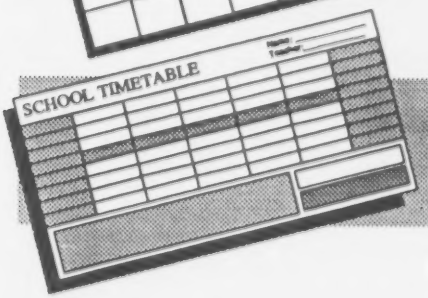
b. What is the least amount of money Sally would have to spend in order to have one of the three bulletin boards in part a.?

Posters:

	Length	Width
A.	69cm	X 55cm
B.	61cm	X 48cm
C.	53cm	X 43cm

Calendars:

	Length	Width
A.	44cm	X 30cm
B.	58cm	X 26cm
C.	29cm	X 26cm



Timetables:

	Length	Width
A.	21cm	X 28cm
B.	14cm	X 26cm
C.	22cm	X 18cm

Division III
A Frame-Up

THE PROBLEM

Sally is designing a bulletin board for her room. She wants to make it large enough to hold a poster, a calendar and her timetable, as well as have extra space for odds and ends. The cork board material she is going to use costs $25.00 per square metre She has saved $23.80 to spend.

a. Select one item from each list in the chart below to help Sally design a rectangle shaped bulletin board. Design a bulletin board which has: (i) 40% free space; (ii) 50% free space; and, (iii) 60% free space. Draw your design and state the dimensions for each bulletin board, as well as its cost.

b. What is the least amount of money Sally would have to spend in order to have one of the three bulletin boards in part a.?

TEACHERS' GUIDE

Teaching Tips

This problem integrates three strands of the junior high math curriculum with the word processing and spreadsheet applications.

First, introduce the **A Frame-Up** problem to your students using Polya's model. There are several ways of doing this. The method you choose should be based on your own teaching style and the problem-solving skill level of your students (see the "Suggested Activities" section on page 3-77 for some ideas).

The following files are contained on the student disk.

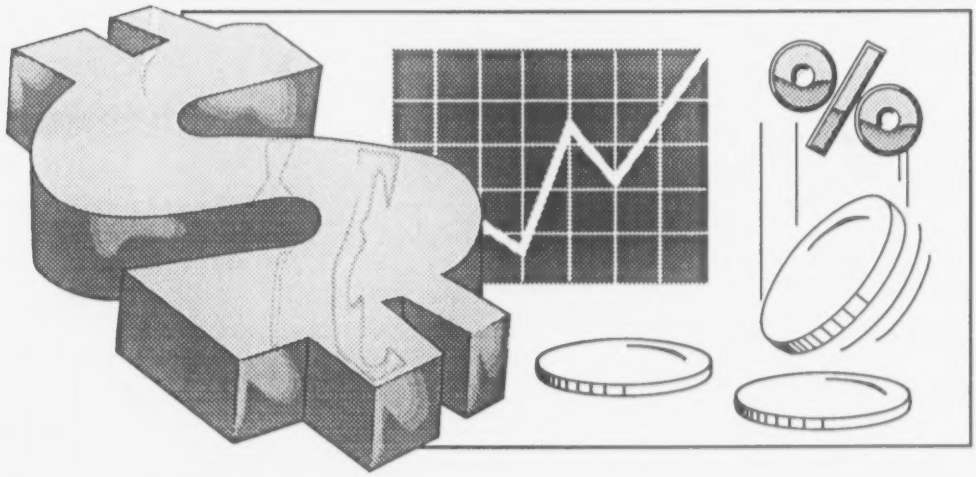
• **FRAMEblank** (word processing file)
This word processing file contains the **A Frame-Up** problem and a blank shell of Polya's model. Students type in their own responses. Also, a master, blank copy of Polya's model is included in Appendix H.

• **FRAME** (spreadsheet)
- Students enter length and width for the bulletin board, poster, calendar and timetable.
- The following are calculated automatically:
  - the area for the bulletine board, poster, calendar and timetable
  - the total area for the poster, calendar and timetable
  - the total cost for the bulletine board
  - the amount of "free space"

Division III
You Can Bank On It

THE PROBLEM

Over the summer you have worked hard to save $625. Part of this money must be used for your expenses in the coming year. You also want your money to work for you. How would you manage your money so that you can earn the maximum amount of interest in one year?



Division III
You Can Bank On It

TEACHERS' GUIDE

THE PROBLEM

Over the summer you have worked hard to save $625. Part of this money must be used for your expenses in the coming year. You also want your money to work for you. How would you manage your money so that you can earn the maximum amount of interest in one year?

Teaching Tips

This problem integrates three strands of the junior high math curriculum with the word processing and spreadsheet applications.

First, introduce the **You Can Bank On It** problem to your students (see the "Suggested Activities" section on page 3-77 for some ideas). This problem allows students to explore several features of chequing and savings accounts. It compares two banks and trust companies, and investments in bonds.

The following files are contained on the student disk.

• **BANKblank** (word processing file)
This word processing file contains the **You Can Bank On It** problem and a blank shell of Polya's model. Students type in their own responses. Also, a master, blank copy of Polya's model is included in Appendix H.

• **BANK** (spreadsheet)
- The Amount column calculates compound interest to give the total amounts and the interest earned for different compounding periods.
- The "Pay Period" column states the length of time, in months, before an investment earns interest.
- The "Number of Pay Periods" column calculates the number of compounding periods for the student's choice of investment time.

Division II
TV Poll

THE PROBLEM

You have a part-time job working for a Media Survey Company. Your job is to collect data and write a report that will be used to forecast future television viewing schedules. Do a survey of your class to discover: a. the most popular TV show; b. the most popular TV channel. Write a report and make several other observations from your survey.

CANADA MEDIA SURVEY COMPANY

Please take a few moments to complete this television program survey:

Name:_____ Gender:_____ Age:_____

Show:_____

Length: _____ Channel: _____ Time: _____

Type: ☐ Adventure ☐ Documentary ☐ Movie
☐ Cartoon ☐ Drama ☐ Musical
☐ Other _____

Thank you for taking the time to complete this form!

Division II
TV Poll

TEACHERS' GUIDE

THE PROBLEM

You have a part-time job working for a media survey company. Your job is to collect data and write a report that will be used to forecast future television viewing schedules. Do a survey of your class to discover: a. the most popular TV show; b. the most popular TV channel. Write a report and make several other observations from your survey.

Teaching Tips

This problem integrates four strands of the junior high math curriculum with the word processing and database applications.

First, introduce the **TV Poll** problem to your students using Polya's model. There are several ways of doing this. The method you choose should be based on your own teaching style and the problem-solving skill level of your students (see the "Suggested Activities" section on page 3-77 for some ideas).

The following files are contained on the student disk.

- **POLLblank** (word processing file)

This word processing file contains the TV Poll problem and a blank shell of Polya's model. Students type in their own responses. Also, a master, blank copy of Polya's model is included in Appendix H.

- **POLLdata** (database)
- Students can survey their class using a simple survey form.
- Collected data are entered into the database.
- The find and sort features of the database are used to so' e the problem.

Chapter 4: CURRICULUM SOFTWARE CORRELATION

How to Use This Correlation Guide	4-3
Curriculum Correlations	4-4
Software Descriptions	4-61

The following software correlations and descriptions are extracted from the Edmonton Public Schools publications, *Computers and the Elementary Mathematics Curriculum* and *Computers and the Junior High Mathematics Curriculum*, and are copied with permission. (See Appendix L of this guide for further details on these publications.)

HOW TO USE THIS CORRELATION GUIDE

1. The strand is in full capital letters and boldface type.
2. The objective is underlined.
3. Titles of disks are typed in full capital letters to the right of the objectives.
4. Settings, levels of play and hints are provided when the program must be adapted to meet the objective as stated.

EXAMPLE (Note: The following does not represent a real correlation.)

1 ..... **NUMERATION**

2 ..... Objective 1:
Rounds whole numbers
(Limit: the nearest thousand.)

3 ..... 1. ELEMENTARY MATHEMATICS, Vol. 1, MECC
4 ..... • Round

2 ..... Objective 4:
Identifies, reads and writes a fraction to represent a point on a number line, a part of a region or a part of a set (emphasis on halves, thirds, quarters, fifths and tenths).

3 ..... 1. FRACTION PRACTICE UNLIMITED, ver. 1.0, MECC
4 ..... • Sorter
Set denominators to 2, 3, 4 and 10: difficulty to EM.
3 ..... 2. MAC 4, Mathematics Activities Courseware, Houghton Mifflin
4 ..... • Fraction Clues

Please Note: The titles of the student learning resources identified were provided through the courtesy of Edmonton Public School Board. This listing is not to be construed as an explicit or implicit departmental approval for use. These titles are provided as a service only to assist local jurisdictions to identify resources that contain potentially useful ideas for teachers. The responsibility to evaluate these resources prior to selection rests with the local jurisdiction according to local policy.

CURRICULUM CORRELATIONS

Matching Software To Grade Four Objectives

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4
NUMERATION	
Objective 1: Rounds whole numbers (limit: to the nearest thousand).	1. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Round 2. CONQUERING MATH WORKSHEET GENERATOR, ver.1.0, MECC • Set 1-8. Based on Conquering Math series.
Objective 3: Identifies and names place value of digits (0.01 to 99,999).	1. MAC 4, Houghton Mifflin • Number Ladders 2. CONQUERING MATH WORKSHEET GENERATOR, ver.1.0, MECC • Set 1-8. Based on Conquering Math series.
Objective 4: Identifies, reads and writes a fraction to represent a point on a numer line, a part of a region or a part of a set (emphasis on halves, thirds, quarters, fifths and tenths).	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-8. Based on Conquering Math series. 2. FRACTION FACTORY, Springboard • Fractions • Sets 3. FRACTION PRACTICE UNLIMITED, ver. 1.0, MECC • Sorter Set denominators to 2, 3, 4 and 10; difficulty to E, M. 4. MAC 4, Houghton Mifflin • Fraction Clues

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4
Objective 5: Identifies equivalent fractions.	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-8. Based on Conquering Math series. 2. FRACTION FACTORY, Springboard • Equivalent Fractions 3. FRACTION MUNCHERS, ver. 1.0, MECC • Equivalent Fractions 4. FRACTION PRACTICE UNLIMITED, MECC • Factory Set denominators to 2, 3, 4 and 10; difficulty to E, M. • Stomper Set denominators to 2, 3, 4 and 10; difficulty to E, M.
Objective 6: Reads, writes and orders whole numbers and decimals (0.01 to 99,999).	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PA 1-4. 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Number Tell student to choose 100,000 or less. 3. ESTIMATION, ver. 1.1, MECC • Number Line Use levels 1, 2. 4. MAC 3, Houghton Mifflin • We're Counting – On You

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4

OPERATIONS AND PROPERTIES

Objective 1:
Adds and subtracts numbers using standard and expanded notation.

1. ADDITION LOGICIAN, ver. 1.0, MECC
   - Race Time
   - Repeat After Me
   - The Fence Game
   - Three in a Row
   - Zebug Nim

2. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC
   - Choose MECC objective # PB 43-45.

3. COMPUTER GENERATED MATH MATERIALS, Vol. 2, MECC
   - For addition and subtraction, choose objective #PP 33.
   - For addition, choose objective # PA 8-10, 12-19.
   - For addition, choose objective # PP 3-4, PP 6-10.
   - For subtraction, choose objective # PA 30-40, 43.
   - For subtraction, choose objective #PP 11-16.

4. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC
   - Addition
     Set problems to types A, B, C, D.
   - Subtraction
     Set problems to types A, B, C, D.

5. MAC 4, Houghton Mifflin
   - Master Math

6. MAC 6, Houghton Mifflin
   - Master Math

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4
	7. MASTERING MATH WORKSHEET GENERATOR, MECC • For addition, choose objectives # WA 20 - WA 33. • For subtraction, choose objectives # WS 12 - WS 18. 8. TEASERS BY TOBBS, WINGS for learning • Addition Set difficulty level to 3, 5.
Objective 2: Multiplies whole numbers by one- and two-digit whole numbers.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PA 50, 54, 56-58, 61. • Choose MECC objective # PD 1-2, 4. • Choose MECC objective # PP 17-20, PP 34, PP 38. 2. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set A, D Based on Conquering Math series. 3. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC • Multiplication Set problems to type B. 4. MAC 3, Houghton Mifflin • Missing Numbers GRADE FOUR 5. MAC 4, Houghton Mifflin • Asteroid Ace • Mt. Multiplication 6. MAC 6, Houghton Mifflin • Multi-Targets 7. MASTERING MATH WORKSHEET GENERATOR, MECC • For multiplication, choose objectives # WM 6, 8, 10-12, 17-20.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4
Objective 4: Understands the associative property of addition and of multiplication.	1. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC • Choose MECC objective # PT 12.
Objective 5: Demonstrates mastery of basic facts for sums and minuends to 18 and products and dividends through 81.	1. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC • Choose objective # PB 7, 8. • Choose objective # PT 13,14, 27-29, 45-46, 54-55. 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Speed Drill Tell students to choose easy or medium level. 3. MAC 3, Houghton Mifflin • Addition Neighbours • Lily Pads • Match a Factor • Subtraction Bridges 4. MAC 4, Houghton Mifflin • Alliteration • Catch a Falling Star • Times Teasers Set to levels 1, 2. 5. MATH BLASTER, Davidson & Assoc. • Add - levels 1, 2 & 3 • Subtract - levels 1, 2, 3 & 4 • Multiply - levels 1, 2, 3 & 4 • Divide - levels 1, 2, 3 & 4

STRAND AND OBJECTIVE | MATCHING SOFTWARE FOR GRADE 4

6. MASTERING MATH WORKSHEET GENERATOR, MECC
   - For addition, choose objectives # WA 1 - WA 6.
   - For division, choose objectives # WD 5 - WD 8.
   - For multiplication, choose objectives # WM 1-5, WM 7.
   - For subtraction, choose MECC objectives # WS 1 - WS 5.

7. MULTIPLICATION PUZZLES, ver. 1.0, MECC
   - Lights Out
   - Paper, Rock, Scissors
   - Tic-Tac-Toe

8. NUMBER MUNCHERS, ver. 1.0, MECC
   - Number Munchers - Multiples
     Set number range to 3-9 and sequence in order.
   - Number Munchers - Equality
     Turn on +, -, x, ÷; set numbers to 1-81 and sequence in order.

9. PATH TACTICS, ver. 1.0, MECC
   Set to multiplying or dividing.

10. QUOTIENT QUEST, MECC
    - African Safari
    - Magic Flags

11. SPEEDWAY MATH, ver. 1.0, MECC
    - Practice Laps
      Turn on +, -, x, ÷, mixed; Number range 0-18 (+, -), 0-9 (x, ÷).
    - The Big Race
      Turn on +, -, x, ÷,mixed; Number range 0-18 (+, -), 0-9 (x, ÷).
    - Tune-up Time
      Turn on +, -, x, ÷, mixed; Number range 0-18 (+, -), 0-9 (x, ÷).

12. TEASERS BY TOBBS, WINGS for learning
    - Addition
      Set difficulty level to 1, 2, 4.
    - Multiplication
      Set difficulty level to 1-5.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4
	13. KING'S RULE (THE), WINGS for learning • Level 1: The Castle Gate Can limit the number of levels on the main menu. • Level 2: The Guard's Room Can limit the number of levels on the main menu.
Objective 6: Divides one- and two-digit whole numbers by a one-digit divisor (with and without remainders). Estimates quotients.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose objective # PD 12, PP 21-22, PP 25-26. 2. MAC 3, Houghton Mifflin • Bertha Eats Basic Facts • Remainder Take-Out 3. MAC 4, Houghton Mifflin • Green Bananas • Remainder Clues 4. MASTERING MATH WORKSHEET GENERATOR, MECC • For division, choose objectives # WD 9-12, 14, 15, 17, 19, 21. 5. QUOTIENT QUEST, ver. 1.0, MECC • Castle Caper • Oriental Tower • Pearl Divers • Totem Switch
Objective 7: Multiplies whole numbers by 10, 100 and 1,000.	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set A, D Based on Conquering Math series. 2. MASTERING MATH WORKSHEET GENERATOR, MECC • Choose MECC objectives # WM 9, WM 11.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4
MEASUREMENT	
Objective 1: Reads and writes time to minutes.	1. CLOCKWORKS, ver. 1.0, MECC • Digital Drill Set time interval to 1 minute. • Set the Clock Set time interval to 1 minute. • What's the Time Set time interval to 1 minute.
Objective 3: Extends estimation and measurement to include the use of the standard units of millimetre, millilitre and gram with symbols mm, mL and g.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PA 125-128. 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Metric 21 • Metric Estimate Tell student to select "centimetre" or "millimetre." 3. MAC 6, Houghton Mifflin • Metric Paths
Objective 5: Uses money for purchasing and making change.	1. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Change 2. MAC 4, Houghton Mifflin • Piggy Bank 3. MONEY WORKS, ver. 1.0, MECC • Counting Change Set to <$0.50 or >$10; units (pennies to bills).

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4
GRAPHING	
Objective 1: Constructs pictographs and bar graphs.	1. EASY GRAPH, Grolier Electronic Publishing
Objective 2: Interprets pictographs and bar graphs.	1. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC • Choose MECC objective # PG 13-19.
Objective 3: Writes coordinates as ordered pairs.	1. COORDINATE MATH, ver. 1.0, MECC • Nomad Set options to graph, rather than map, coordinates. 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Hurkle Tell students to select "on a 10 by 10 grid." 3. GUESSING AND THINKING, ver. 1.0, MECC • Hurkle Student must choose #4. 4. MAC 4, Houghton Mifflin • Coordinate Concentration
Objective 4: Graphs ordered pairs.	1. BUMBLE GAMES, The Learning Company • Bumble Dots • Tic-Tac-Toe • Visit from Space 2. MAC 3, Mathematics Activities Courseware, Houghton Mifflin • Sliding Twins

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 4

PROBLEM SOLVING

SUGGESTED STRATEGIES

1. Understand the Problem

2. Make a Plan

3. Carry Out the Plan

4. Look Back

1. CODE QUEST, Sunburst
   - Student chooses level of difficulty 1, 2, 3 or 4.

2. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC
   - Choose MECC objective # PB 4-7, 43, 44.
   - Choose MECC objective # PS 1-11.
   - Choose MECC objective # PT 1-5, 7-17, 19-22, 27-29, 36, 43-48, 52-55, 63.

3. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC
   - Choose MECC objective # PD 1-2, 4, 12.
   - Choose MECC objective # PM 6, 9-13, 16-17.
   - Choose objective # PP 3-4, 6-10, 11-22, 25-26, 33-34, 38, 44.

4. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC
   - Bagels
     Choose 2, 3 or 4 digits.
   - Bowling

5. ELEMENTARY MATHEMATICS, Vol. 1, MECC
   - Bagels
     Student may choose 2, 3 or 4 digits.

6. FACTORY (THE), WINGS for learning
   - Student may choose easy, medium or hard.

7. GERTRUDE'S PUZZLES, The Learning Company

8. GUESSING AND THINKING, ver. 1.0, MECC
   - Bagels
     Choose 2, 3 or 4 digits.
   - Number
     Choose numbers in ranges: 1-15, 1-50.

9. IN SEARCH OF WARGO, SVE

10. JENNY'S JOURNEYS, ver. 1.0, MECC
    - Short Errand with Jenny
    - Journey Across Town
    - Shopping Trip

11. KING'S RULE (THE), WINGS for learning
    - Level 1: The Castle Gate
      Can limit the number of levels on the main menu.
    - Level 2: The Guard's Room
      Can limit the number of levels on the main menu.

12. LOGOWRITER, L.C.S.I.

13. MEMORY: A FIRST STEP IN PROBLEM SOLVING, Sunburst
    - Simon Says...
      Level of difficulty adjusts to learner.
    - Memory Castle
      Level of difficulty can be set by student.
    - Memory Machine
      Level of difficulty can be set by student.
    - Pick the Part
      Level of difficulty can be set by student.
    - Regrouping
      Level of difficulty can be set by student.
    - Was It There?/Was It Missing?
      Level of difficulty can be set by student.
    - Memory Building Blocks
      Level of difficulty can be set by teacher or student.
    - What's In a Frame?
      Level of difficulty can be set by teacher.

14. MOPTOWN HOTEL, The Learning Company

15. MOPTOWN PARADE, The Learning Company

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE
	16. ROCKY'S BOOTS, The Learning Company 17. SAFARI SEARCH, WINGS for learning • Find the Flamingo • Search Out the Seal • Locate the Loon • Discover the Dragon (Challenge) • Detect the Donkey (Challenge) • Catch the Kittens (Challenge)

Matching Software To Grade Five Objectives

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
NUMERATION	
Objective 1: Identifies and names place value of digits (0.001 to 999,999).	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-6. Based on Conquering Math series.
Objective 2: Rounds whole numbers (limit: to the nearest ten thousand).	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-6. Based on Conquering Math series. 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Round 3. MAC 5, Houghton Mifflin • Rock, Scissors, Paper
Objective 3: Rounds numbers to tenths and hundredths.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PA 97. 2. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-6. Based on Conquering Math series. 3. DECIMAL CONCEPTS, ver. 1.0, MECC • Maze Runner - set thousands used to "no."
Objective 4: Expresses and generates proportional ratios.	1. CONQUERING RATIOS AND PROPORTIONS, ver. 1.0, MECC • Ratio - set problem types to A. • Proportions - set Unit Rate to "on." • Create-A-Flag is approximate. • Catapult Capers - use "Apprentice" level.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
Objective 5: Solves for the missing numeral in proportional ratios without using cross-products.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PA 5-6. 2. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-6. Based on Conquering Math series.
Objective 6: Expresses tenths, hundredths and thousandths as fractions or decimals.	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-6. Based on Conquering Math series. 2. DECIMAL CONCEPTS, ver. 1.0, MECC • Maze Runner • Decimal Duel • Decimal Bounce
Objective 7: Generates equivalent fractions for halves, quarters, fifths, tenths and hundredths.	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-6. Based on Conquering Math series. 2. FRACTION FACTORY, Springboard • Equivalent Fractions 3. FRACTION PRACTICE UNLIMITED, MECC • Factory Set denominators to 2, 3, 4 and 10; difficulty to E, M. • Stomper Set denominators to 2, 3, 4 and 10; difficulty to E, M.
Objective 8: Regroups tenths, hundredths and thousandths.	1. DECIMAL CONCEPTS, ver. 1.0, MECC • Maze Runner Set 8 - set thousands to "no."

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
	2. MATH BLASTER, Davidson & Assoc. • Fractions and Decimals - level 3
Objective 9: Reads, writes and orders whole numbers and decimals (0.001 to 999,999).	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set 1-6. Based on Conquering Math series. 2. MAC 5, Houghton Mifflin • Decimal Ladders
OPERATIONS AND PROPERTIES	
Objective 1: Adds and subtracts whole numbers. Estimates sums and differences.	1. ADDITION LOGICIAN, ver. 1.0, MECC • Race Time • Repeat After Me • The Fence Game 2. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC • Choose MECC objective # PB 43-45, 67. 3. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • For addition, choose MECC objective #PA 14-19, 20-24. • For subtraction, choose MECC objective #34-38, 40, 43-47. 4. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC • Addition Set problems to types A, B, C, D. • Subtraction Set problems to types A, B, C, D. 5. ESTIMATION, ver. 1.1, MECC • Estimate Set to +, -, x, ÷. 6. KING'S RULE (THE), WINGS for learning • Level 1: The Castle Gate Can limit the number of levels on the main menu. 7. MAC 4, Houghton Mifflin • Master Math

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
	8. MAC 5, Houghton Mifflin • Add-gitation 9. MAC 6, Houghton Mifflin • Master Math 10. MASTERING MATH WORKSHEET GENERATOR, MECC • For addition, choose MECC objectives # WA 30 - WA 34. • For subtraction, choose MECC objectives # WS 16 - WS 18. 11. TEASERS BY TOBBS, WINGS for learning • Addition Set difficulty level to 3, 5, 6.
Objective 2: Demonstrates mastery of basic facts.	1. COMPUTER GENERATED MATH , Vol. 1, ver. 1.3, MECC • Choose MECC objective # PT 29-30, 31-32, 45-49, 56-59. 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Speed Drill Tell student to choose easy or medium level +, -, x, or +. 3. KING'S RULE (THE), WINGS for learning • Level 2: The Guard's Room Can limit the number of levels on the main menu. 4. MAC 4, Houghton Mifflin • Alliteration • Times Teasers Set to levels 1, 2. 5. MASTERING MATH WORKSHEET GENERATOR, MECC • For addition, choose MECC objectives #WA 1 - WA 6. • For division, choose MECC objectives #WD 5 - WD 8. • For multiplication, choose MECC objectives # WM 1-5, 7. • For subtraction, choose MECC objectives # WS 1 - WS 5.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
	6. MATH BLASTER, Davidson & Assoc. • Add- levels 1-5 • Subtract- levels 1-5 • Multiply- levels 1-4 • Divide- levels 1-4 7. MULTIPLICATION PUZZLES, ver. 1.0, MECC • Lights Out • Paper, Rock, Scissors • Tic-Tac-Toe 8. NUMBER MUNCHERS, ver. 1.0, MECC • Number Munchers - Equality Turn on +,-,x,÷; set numbers to 1-81 and sequence in order. • Number Munchers - Multiples Set number range to 3-9 and sequence in order. 9. TEASERS BY TOBBS, WINGS for learning • Addition Set difficulty level to 1, 2, 4. • Multiplication Set difficulty level to 1-6.
Objective 3: Multiplies whole numbers using one-, two- and three-digit multipliers. Estimates products.	1. COMPUTER GENERATED MATH Vol. 1, ver. 1.3, MECC • Choose MECC objectives # PB 46, PA 50-51, 54, 56-58, 61-64. 2. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Sets A, B, C, D Based on Conquering Math series. 3. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC • Multiplication Set problems to types A, B, C, D. 4. ELEMENTARY MATHEMATICS, ver. 1.0, MECC • Tens 5. ESTIMATION, ver. 1.0, MECC • Estimate Set to +, -, x, ÷.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
	6. MAC 3, Houghton Mifflin • Missing Numbers 7. MAC 4, Houghton Mifflin • Asteroid Ace 8. MAC 5, Houghton Mifflin • Product Targets 9. MAC 6, Houghton Mifflin • Multi-Targets 10. MASTERING MATH WORKSHEET GENERATOR, MECC • For multiplication, choose MECC objectives # WM 18 - 20. 11. MULTIPLICATION PUZZLES, ver. 1.0, MECC • Carrot Patch • Desert Island • Zoo Trip
Objective 4: Divides whole numbers using one- and two-digit divisors (with and without remainders). Estimates quotients.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.0, MECC • Choose MECC objective # PA 72-77, PP 23-24, PP 27-32, PP 36-37, PD 10-13, 24. 2. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set A, B, C, D. Based on Conquering Math series. 3. CONQUERING WHOLE NUMBERS, MECC • Division Set problems to types A, B. 4. ESTIMATION, ver. 1.1, MECC • Estimate Set to +, -, x, ÷. 5. MAC 3, Houghton Mifflin • Remainder Take-Out 6. MAC 4, Houghton Mifflin • Green Bananas • Remainder Clues

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
	7. MAC 5, Houghton Mifflin • Ticky Tacky Toe • Tug of War (also on MAC 6) 8. MAC 6, Houghton Mifflin • Tug of War (also on MAC 5) 9. MASTERING MATH WORKSHEET GENERATOR, MECC • For division, choose MECC objectives # WD 9 - WD 21. 10. QUOTIENT QUEST, ver. 1.0, MECC • Castle Caper • Oriental Tower • Totem Switch
Objective 5: Multiplies and divides whole numbers and decimals by 10, 100 and 1,000.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PD 7. 2. CONQUERING DECIMALS (x, ÷), ver. 1.0, MECC • Set D. 3. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set A, B, C, D. Based on Conquering Math series. 4. MASTERING MATH WORKSHEET GENERATOR, MECC • For multiplication, choose MECC objectives # WM 10, 11.
Objective 6: Adds, subtracts and multiplies decimals (sums, differences and products to thousandths).	1. COMPUTER GENERATED MATH MATERIALS, Vol. 1, ver. 1.3, MECC • Choose MECC objective # PB 13-18, 49-52. 2. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • For addition, choose objective # PA 82-84, 88-90, 92, 96. • For subtraction, choose MECC objective # PA 97-98, 101. • For multiplication, choose MECC objective # PA 102-103. • Choose MECC objective # PD 6.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
	3. CONQUERING DECIMALS (+, -), ver. 1.0, MECC 4. CONQUERING DECIMALS (x, ÷), ver. 1.0, MECC 5. DECIMALS CONCEPTS, MECC • Use all games. 6. MAC 4, Houghton Mifflin • Decimal Rally 7. MAC 5, Houghton Mifflin • Three In a Row
Objective 7: Divides decimals by one-digit whole numbers.	1. COMPUTER GENERATED MATH MATERIALS, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PA 110, PD 18-19. 2. CONQUERING DECIMALS (x, ÷), ver. 1.1, MECC • Set A.
MEASUREMENT	
Objective 3: Extends estimations and measurements including tonne and its symbol *t*.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PA 127-128. 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Metric Estimate Tell student to select "centimetre" or "millimetre." 3. M[illegible], Houghton Mifflin • Metric P[illegible]ths • R[illegible] Soccer to Scale
Objective 9: Expresses equivalent linear measures.	1. ELEMENTARY MATHEMATICS, Vol.1, MECC • Metric Length

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
Objective 10: Finds perimeter of polygons without using formulas.	1. MAC 5, Houghton Mifflin • Centipede Racers
Objective 11: Finds area of polygons without using formulas.	1. MAC 4, Houghton Mifflin • Area Estimation 2. MAC 5, Houghton Mifflin • Centipede Racers
GEOMETRY	
Objective 3: Identifies and draws translations (slides), reflections (flips) and rotations (turns) of two-dimensional figures.	1. MAC 4, Houghton Mifflin • Figure Fast 2. MAC 5, Houghton Mifflin • Same Shape, Same Size 3. MAC 6, Houghton Mifflin • Slide-Flip-Turn 4. SUPER FACTORY (THE), Sunburst • Easy, Medium, Hard, Super
GRAPHING	
Objective 1: Constructs pictographs, bar and line graphs.	1. EASY GRAPH, Grolier Electronic Publishing 2. MECC GRAPH, ver. 1.1, MECC • Graph Name/Number Data
Objective 2: Interprets and solves problems using pictographs, bar, line and circle graphs.	1. COMPUTER GENERATED MATH MATERIALS, Vol. 1, ver. 1.3, MECC • Choose MECC objective # PG 20-29.
Objective 3: Reads and writes coordinates from a graph.	1. COORDINATE MATH, ver. 1.0, MECC • Nomad Set options to graph, rather than map, coordinates. 2. GUESSING AND THINKING, ver.1.0, MECC • Hurkle Student must choose #4.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5
Objective 4: Graphs ordered pairs.	1. BUMBLE GAMES, The Learning Company • Bumble Dots • Tic Tac Toe 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Hurkle Tell students to select on a 10 by 10 grid. 3. MAC 4, Houghton Mifflin • Coordinate Concentration 4. MAC 5, Houghton Mifflin • Coordinates Corral 5. MECC GRAPH, ver. 1.1, MECC • Graph Number Pair Data 6. NUMBER QUEST, Sunburst • Numbers in a Plane
PROBLEM SOLVING	
SUGGESTED STRATEGIES 1. Understand the Problem 2. Develop a Plan 3. Carry out the Plan 4. Look Back	1. CODE QUEST, Sunburst • Student chooses level of difficulty 1-6. 2. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC • Choose objective # PB 8, 27, 45, 46, 49. • Choose objective # PT 10-17,19-24, 29-31, 45-49, 56-60, 63. 3. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose objective # PD 6-7, 10-13, 18-19, 24. • Choose objective # PP 23-24, 27-32, 36-38. • Choose objective # PM 16-19.

4. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC
   - Bagels
     Choose 2, 3 or 4 digits.
   - Tax Collector
     Choose from 6-50 numbers.
   - Bowling

5. ELEMENTARY MATHEMATICS, Vol. 1, MECC
   - Bagels
     Student may choose 2, 3 or 4 digits.

6. FACTORY (THE), Sunburst
   Student may choose easy, medium or hard.

7. GERTRUDE'S PUZZLES, The Learning Company

8. GUESSING AND THINKING, ver. 1.0, MECC
   - Number
     1-100,000.
   - Bagels
     2, 3 or 4 digits.

9. JENNY'S JOURNEYS, ver. 1.0, MECC
   - Short Errand with Jenny
   - Journey Across Town
   - Shopping Trip

10. KING'S RULE (THE), WINGS for learning
    - Level 1: The Castle Gate
    - Level 2: The Guard's Room
      Can limit the number of levels on the main menu.

11. LOGOWRITER, L.C.S.I.

12. MEMORY: A FIRST STEP TO PROBLEM SOLVING, Sunburst
    - Simon Says...
      Level of difficulty adjusts to learner.
    - Memory Castle
      Level of difficulty can be set by student.
    - Memory Machine
      Level of difficulty can be set by student.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 5

- Pick the Part
  Level of difficulty can be set by student.
- Regrouping
  Level of difficulty can be set by student.
- Was It There?/Was It Missing?
  Level of difficulty can be set by student.
- Memory Building Blocks
  Level of difficulty can be set by teacher or student.
- What's In a Frame?
  Level of difficulty can be set by teacher.

13. MOPTOWN HOTEL, The Learning Company

14. MOPTOWN PARADE, The Learning Company

15. PROBLEM-SOLVING STRATEGIES, MECC
    - Diagonals
    - Squares
    - Thinking with Ink
      The size of the maps can be changed.

16. ROCKY'S BOOTS, The Learning Company

17. SAFARI SEARCH, WINGS for learning
    - Find the Flamingo
    - Search out the Seal
    - Locate the Loon
    - Discover the Dragon
    - Detect the Donkey
    - Catch the Kittens (Challenge)
    - Round Up the Rhinos (Challenge)
    - Sight the Snails (Challenge)

18. SUPERFACTORY (THE), WINGS for learning
    - Student can choose easy, medium, hard or super.

Matching Software To Grade Six Objectives

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
NUMERATION	
Objective 1: Identifies and names place values to billions (0.0001 to 1,000,000,000).	1. DECIMAL CONCEPTS, ver. 1.0, MECC
Objective 3: Rounds numbers (0.0001 to 999,999,999).	1. DECIMAL CONCEPTS, ver. 1.0, MECC 2. ELEMENTARY MATHEMATICS, Vol. 1.1, MECC • Round 3. MAC 5, Houghton Mifflin • Rock, Scissors, Paper
Objective 4: Identifies and uses proportional ratios.	1. CONQUERING MATH WORKSHEET GENERATOR, ver.1.0, MECC • Set A, B, C. 2. CONQUERING RATIOS AND PROPORTIONS, ver. 1.0, MECC
Objective 5: Expresses halves, quarters and fifths as fractions or decimals.	1. CONQUERING PERCENTS, ver. 1.0, MECC • Percent Factory and Percent Chompers only. 2. DECIMAL CONCEPTS, ver. 1.0, MECC 3. MATH BLASTERS, Davidson & Assoc. • Fractions and Decimals - level 3 4. NUMBER QUEST, Sunburst • Numbers in a line then Fractions.
Objective 6: Expresses fractions and decimals as percents and vice versa.	1. CONQUERING PERCENTS, ver. 1.0, MECC • Percent Factory and Percent Chompers.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
Objective 8: Reads, writes and orders whole numbers and decimals (0.0001 to 1,000,000,000).	1. DECIMAL CONCEPTS, MECC 2. MAC 5, Houghton Mifflin • Decimal Ladders 3. MAC 6, Houghton Mifflin • Decimal Hunt 4. NUMBER QUEST, Sunburst • Numbers in a line then Decimals. 5. CONQUERING DECIMALS (+, -), ver. 1.0, MECC
OPERATIONS AND PROPERTIES	
Objective 1: Adds and subtracts whole numbers and decimals. Estimates sums and differences.	1. ADDITION LOGICIAN, ver. 1.0, MECC • Race Time • Repeat After Me 2. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC • Choose MECC objective # PB 13-15, 25-27, 31-33, 49-51, 67-68. 3. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • For addition of whole numbers, choose # PA 18-24. • For addition of decimals, choose # PA 84-85, 90-92, 96. • For subtraction of whole numbers, choose # PA 43-49. • For subtraction of decimals, choose # PA 97-98, 101. 4. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set A, B, C, D. Based on Conquering Math series. 5. DECIMAL CONCEPTS, ver. 1.0, MECC

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
	6. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC • Addition Set problems to types A, B, C, D. • Subtraction Set problems to types A, B, C, D. 7. ESTIMATION, ver. 1.1, MECC • Shopping 8. MAC 4, Houghton Mifflin • Decimal Rally 9. MAC 5, Houghton Mifflin • Add-gitation 10. MAC 6, Houghton Mifflin • Master Math 11. TEASERS BY TOBBS, WINGS for learning • Addition Set difficulty level to 3, 5, 6.
Objective 2: Demonstrates mastery of basic facts.	1. COMPUTER GENERATED MATH MATERIALS, Vol. 1, ver. 1.3, MECC • Choose MECC objective # PT 32, 49. 2. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Speed Drill Tell student to choose easy or medium level +, -, x, or ÷. 3. MATH BLASTER, Davidson & Assoc. • Add- levels 1-5 • Subtract- levels 1-5 • Multiply- levels 1-4 • Divide- levels 1-4 4. MULTIPLICATION PUZZLES, ver. 1.0, MECC • Lights Out • Paper, Rock, Scissors • Tic-Tac-Toe 5. NUMBER MUNCHERS, ver 1.0, MECC • Number Munchers - Equality Turn on +, -, x, ÷; set numbers to 1-81 and sequence in order.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
	6. TEASERS BY TOBBS, WINGS for learning • Addition Set difficulty level to 1, 2, 4. • Multiplication Set difficulty level to 1-6.
Objective 3: Multiplies whole numbers and decimals using one-, two-, and three-digit multipliers. Estimates products.	1. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC • Choose objective # PB 10-12,16-18, 28-30, 34-36, 46-48, 52-54. 2. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • For whole numbers, choose MECC objective # PA 62-67. • For decimals, choose MECC objective # PA 107-108. • Choose MECC objective # PD 7, PD 23. 3. CONQUERING DECIMALS (x, ÷) ver. 1.1, MECC • Set A, B. Teacher option permits setting problem, changing phrases, access to games, student scores. 4. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set A, B, C, D. Based on Conquering Math series. 5. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC • Multiplication Set problems to types A, B, C, D. 6. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Tens 7. MAC 4, Houghton Mifflin • Asteroid Ace

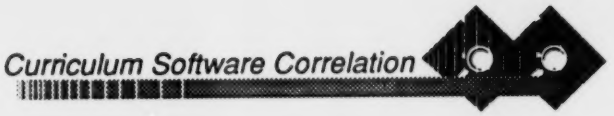
STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
	8. MAC 5, Houghton Mifflin • Product Targets • Three In a Row 9. MAC 6, Houghton Mifflin • Multi-Maze • Multi-Targets
Objective 4: Divides whole numbers and decimals using one-, two-, and three-digit whole number divisors.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • For whole numbers, choose MECC objective # PA 72-80. • For decimals, choose MECC objective #PA 110-113. • Choose MECC objective # PD 13-14. 2. CONQUERING DECIMALS (x, ÷), ver. 1.0, MECC • Set A, B. Teacher options permit setting problem changing phrases, access to games, student scores. 3. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set A, B, C, D. Based on Conquering Math series. 4. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC • Division Set problems to types A, B, C, D. 5. MAC 5, Houghton Mifflin • Ticky Tacky Toe • Tug of War (also on MAC 6) 6. MAC 6, Houghton Mifflin • Tug of War (also on MAC 5) 7. QUOTIENT QUEST, ver. 1.0, MECC • Castle Caper • Oriental Tower • Totem Switch

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
Objective 5: Divides whole numbers and decimals using one decimal place divisors.	1. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PA 119. 2. COMPUTER GENERATED MATH, Vol. 2, ver. 1.1, MECC • Choose MECC objective # PD 20.
Objective 7: Mentally computes simple addition, subtraction, multiplication and division.	1. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Speed Drill Tell student to choose easy, medium or hard levels.
Objective 8: Calculates averages and percentages.	1. CONQUERING MATH WORKSHEET GENERATOR, ver. 1.0, MECC • Set A, B, C, D. Based on Conquering Math series. 2. CONQUERING PERCENT, ver. 1.0, MECC • Everything's on Sale • Percent Chompers
MEASUREMENT	
Objective 1: Finds perimeter of polygons with and without formulas.	1. GEOMETRIC CONCEPTS - PERIMETER, Jostens Learning Systems 2. MAC 4, Houghton Mifflin • Area Estimation
Objective 2: Finds areas of triangles and rectangles using formulas.	1. GEOMETRIC CONCEPTS - AREA, Jostens Learning Systems

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
Objective 4: Reads and determines distances according to a scale.	1. MAC 6, Houghton Mifflin • Bonus: Soccer to Scale
Objective 8: Expresses equivalent measures within units of length, capacity, mass and time with symbols.	1. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Metric Length
Objective 9: Measures angles.	1. COORDINATE MATH, ver. 1.0, MECC • Radar Set heading to angles. 2. GEOMETRIC PRESUPPOSER, Sunburst • Choose measure. 3. MAC 6, Houghton Mifflin • Learning All the Angles
GEOMETRY	
Objective 2: Draws and identifies radius, diameter and circumferences.	1. GEOMETRIC PRESUPPOSER, Sunburst • Label • Draw
Objective 3: Translates, rotates, reflects and enlarges two-dimensional figures.	1. MAC 5, MATHEMATICS ACTIVITIES COURSEWARE, Houghton Mifflin • Same Shape, Same Size
Objective 4: Identifies and tests congruency using translations (slides), reflections (flips) and rotations (turns).	1. MAC 4, Houghton Mifflin • Figure Fast 2. MAC 6, Houghton Mifflin • Slide-Flip-Turn 3. SUPER FACTORY (THE), Sunburst • Easy, Medium, Hard, Super

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
Objective 5: Identifies and names intersecting lines, parallel lines, perpendicular lines and angles.	1. GEOMETRIC PRESUPPOSER: POINTS & LINES, Sunburst • Set parallel. • Set perpendicular. • Set intersection.
GRAPHING	
Objective 1: Constructs pictographs, bar and line graphs.	1. EASY GRAPH, Grolier Electronic Publishing 2. MECC GRAPH, ver. 1.0, MECC • Graph Name/Number Data • Graph Number Pair Data
Objective 3: Locates points in all four quadrants.	1. BUMBLE PLOT, The Learning Company • Bumble Art • Bumblebug • Hidden Treasure • Roadblock 2. COORDINATE MATH, MECC • Nomad Set options to graph, rather than map, coordinates. • Radar Set heading to coordinates. • Snark 3. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Hurkle Tell students to select on a 5 by 5 grid. 4. GUESSING AND THINKING, ver. 1.0, MECC • Hurkle Student must choose #5. 5. MAC 5, Houghton Mifflin • Coordinates Corral

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 6
	6. MAC 6, Houghton Mifflin • Sketch a Picture 7. NUMBER QUEST, Sunburst • Numbers in a Plane
Objective 4: Generates and graphs ordered pairs from a given relationship.	1. MECC GRAPH, ver. 1.0, MECC • Graph Number Pair Data
PROBLEM SOLVING	
SUGGESTED STRATEGIES 1. Understand the Problem 2. Make a Plan 3. Carry Out the Plan 4. Look Back	1. CODE QUEST, Sunburst • Student chooses level of difficulty 1-7. 2. COMPUTER GENERATED MATH, Vol. 1, ver. 1.3, MECC • Choose MECC objective # PB 45, 46, 50, 51. • Choose MECC objective # PB 9, 13, 14, 31. • Choose MECC objective # PT 14-17, 21-26, 29-32 ,49 , 62-64. 3. COMPUTER GENERATED MATH MATERIALS, Vol. 2, ver. 1.0, MECC • Choose MECC objective # 13-14, 20, 23. 4. CONQUERING WHOLE NUMBERS, MECC • Bagels • Bowling • Tax Collector 5. ELEMENTARY MATHEMATICS, Vol. 1, MECC • Bagels Student may choose 2, 3 or 4 digits. 6. FACTORY (THE), WINGS for learning • Students may choose easy, medium or hard. 7. GERTRUDE'S PUZZLES, The Learning Company



STRAND AND OBJECTIVE

MATCHING SOFTWARE FOR GRADE 6

8. GUESSING AND THINKING, MECC
   - Bagels
   - Number

9. JENNY'S JOURNEYS, ver. 1.0, MECC
   - Short Errand with Jenny
   - Journey Across Town
   - Shopping Trip

10. KING'S RULE (THE), WINGS for learning
    - Level 1: The Castle Gate
    - Level 2: The Guard's Room
    - Level 3: The Game Parlour

    Teacher can limit the number of levels on the main menu.

11. LOGOWRITER, L.C.S.I.

12. MEMORY: A FIRST STEP TO PROBLEM SOLVING, Sunburst
    - What's In a Frame?
    - Memory Castle
    - Memory Machine
    - Pick the Part
    - Regrouping
    - Was It There?/Was It Missing?
    - Memory Building Blocks
    - Simon Says...

13. MIND PUZZLES, ver. 1.2, MECC
    - Mazes of Rodentia
      Knights of Cheddar, Havarti, Brie
      (7 levels).
    - Queen Bee of Menta
      Apprentice beekeeper level 1, 2.

14. MOPTOWN HOTEL, The Learning Company

15. PROBLEM-SOLVING STRATEGIES, MECC
    - Diagonals
    - Pooling Around
      Level of difficulty can be changed 1-4.
    - Squares
    - Thinking with Ink
      The size of the maps can be changed.

16. ROCKY'S BOOTS, The Learning Company

17. SAFARI SEARCH, Sunburst
    - Find the Flamingo
    - Search Out the Seal
    - Locate the Loon
    - Discover the Dragon
    - Detect the Donkey
    - Catch the Kittens (Challenge)
    - Round up the Rhinos (Challenge)
    - Sight the Snails (Challenge)
    - Collect the Kangaroos (Challenge)

18. SUPER FACTORY (THE), WINGS for learning
    - Students may choose easy, medium, hard or super.

Matching Software To Grade Seven Objectives

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 7
PROBLEM SOLVING	
Objective 1: Demonstrates an understanding of a problem-solving situation.	1. KING'S RULE (THE), WINGS for learning • Use to review number sequences.
Objective 2: Demonstrates a willingness to find a solution to a problem.	1. KING'S RULE (THE), WINGS for learning • Use to review number sequences.
Objective 3a: Uses a variety of strategies to solve problems. Understanding the problem.	1. KING'S RULE (THE), WINGS for learning • Use to review number sequences.
Objective 3b: Uses a variety of strategies to solve problems. Making a plan.	1. GEARS, Sunburst 2. KING'S RULE (THE), WINGS for learning • Use to review number sequences. 3. MIND PUZZLES, ver. 1.2, MECC • Mazes of Rodentia - easy • Queen Bee of Manta - harder
Objective 3c: Uses a variety of strategies to solve problems. Carrying out the plan.	1. MIND PUZZLES, ver. 1.2, MECC • Mazes of Rodentia - easy • Queen Bee of Manta - harder 2. PROBLEM-SOLVING STRATEGIES, MECC

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 7
NUMBER SYSTEMS AND OPERATIONS	
Objective 2: Uses mental computation, paper-and-pencil algorithms, estimation and calculators to perform computations.	1. MAC 7, Houghton Mifflin • #10 Number Patterns
A. WHOLE NUMBERS	
Objective A1: Maintains previously developed skills with whole numbers (place value, standard and expanded forms, adding, subtracting, multiplying and dividing).	1. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC 2. MATH SEQUENCES, Milliken • Disks: +, -, x, ÷, Laws of Arithmetic 3. NUMBER MUNCHERS, ver. 1.0, MECC • Set 1, 4, 5, 6. 4. MAC 6, Houghton Mifflin • Disk A: 2, 3, 4 5. POWER DRILL, Sunburst • Set skill levels.
Objective A4: Writes the value of a power (whole number base and exponent).	1. MAC 8, Houghton Mifflin • #2A Power Properties
Objective A5: Applies the rules for the order of operations to evaluate expressions.	1. MAC 7, Houghton Mifflin • #4 Calculator Quiz
Objective A6: Recognizes to prime numbers (Limit: primes to 50.)	1. NUMBER MUNCHERS, ver. 1.0, MECC • Set 3, 6. 2. HOLTMATH 7, Holt • Set for factors and prime numbers.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 7
Objective A7: Lists the set of factors for whole numbers up to 200.	1. NUMBER MUNCHERS, ver. 1.0, MECC • Set 2, 6. 2. HOLTMATH 7, Holt • Set for factors and prime numbers.
Objective A8: Expresses a number as a product of its prime factors.	1. HOLTMATH 7, Holt • Set for GCF and LCM.
B. DECIMALS	
Objective B1: Maintains previously developed skills with decimal numbers (place value, expanded and standard forms, adding, subtracting, multiplying and dividing).	1. CONQUERING DECIMALS (+, -), ver. 1.0, MECC • Provides practice. 2. CONQUERING DECIMALS (x, ÷), ver. 1.0, MECC • Provides practice. 3. DECIMAL CONCEPTS, ver. 1.0, MECC • Use place value and adding decimals only. 4. MAC 6, Houghton Mifflin • Disk A: #1, Disk B: #8 5. MAC 7, Houghton Mifflin • #1A, Decimal Dynamite and #1B, The Last Move 6. MAC 8, Houghton Mifflin • #2B, Closing In 7. MATH SEQUENCES, Milliken • Disk: Decimals

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 7
Objective B2: Compares and orders decimal numbers.	1. DECIMAL CONCEPTS, ver. 1.0, MECC 2. MAC 7, Houghton Mifflin • #2 Multi-Master 3. MATH SEQUENCES, Milliken • Disk: Decimals 4. NUMBER QUEST, Sunburst • Set 1, part 3 only.
Objective B3: Rounds decimal numbers.	1. CONQUERING DECIMALS (x, ÷), MECC 2. DECIMAL CONCEPTS, ver. 1.0, MECC
C. FRACTIONS	
Objective C1: Maintains previously developed skills with fractions (concept of a fraction, need for fractional numbers, equivalent fractions, basic fractions) at a concrete level.	1. ALGEBRA DRILL AND PRACTICE 1, Conduit • Disk 1: set 2. 2. FRACTION CONCEPTS, ver. 1.0, MECC • Use Crusher and Unitizer. 3. FRACTION MUNCHERS, MECC 4. MAC 7, Houghton Mifflin • #8A, Animal Farm
Objective C2: Identifies mixed numbers and improper fractions and converts from one to the other.	1. CONQUERING FRACTIONS (+, -), ver. 1.0, MECC • Gives practice. 2. FRACTION MUNCHERS, ver. 1.0, MECC 3. FRACTION PRACTICE UNLIMITED, ver. 1.0, MECC
Objective C3: Orders fractional numbers.	1. FRACTION CONCEPTS, ver. 1.0, MECC 2. FRACTION MUNCHERS, ver. 1.0, MECC 3. FRACTION PRACTICE UNLIMITED, ver. 1.0, MECC

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 7
	4. MAC 7, Houghton Mifflin • #8A, Animal Farm 5. MATH SEQUENCES, Milliken • Disk: Fractions 6. NUMBER QUEST, Sunburst • Set 2, part 2.
Objective C4: Uses concrete manipulatives to demonstrate the addition and subtraction of fractions with and without common denominators.	1. ALGEBRA DRILL AND PRACTICE 1, Conduit • Disk 1: set 2. 2. CONQUERING FRACTIONS (+, -), ver. 1.0, MECC • Gives practice. 3. MAC 7, Houghton Mifflin • #8B, Fraction Challenge 4. MATH SEQUENCES, Milliken • Disk: Fractions
Objective C5: Writes number sentences to describe the addition and subtraction of fractions.	1. MAC 6, Houghton Mifflin • Disk C: #14
Objective C6: Uses concrete manipulatives to demonstrate the multiplication and division of proper fractions.	1. ALGEBRA DRILL AND PRACTICE 1, Conduit • Disk 1: set 2 2. HOLTMATH 7, Holt • Disk 3 3. MAC 6, Houghton Mifflin • Disk B: #10 4. MAC 7, Houghton Mifflin • #9, Fraction Challenge 11 5. MATH SEQUENCES, Milliken • Disk: Fractions

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 7
D. INTEGERS	
Objective D1: Maintains previously developed skills with integers (concept of integers, need for integers, ordering of integers).	1. MAC 7, Houghton Mifflin • #14, Operation Integers 2. MATH SEQUENCES, Milliken • Disk: Integers
Objective D2: Uses concrete manipulatives to demonstrate the addition of integers.	1. HOLTMATH 7, Holt • Disk 5: section 1 only 2. MATH SEQUENCES, Milliken • Disk: Integers
RATIO AND PROPORTION	
Objective 1: Applies and practises problem-solving skills in new situations.	1. CONQUERING RATIOS AND PROPORTIONS, ver. 1.0, MECC
Objective 2: Maintains previously developed skills (identifies ratios as ordered pairs of numbers related to concrete situations; uses whole number constants to generate equivalent ratios).	1. MATH SEQUENCES, Milliken • Disk: Percent
Objective 4: Verifies the equivalence of two ratios using common multiples or factors.	1. MAC 8, Houghton Mifflin • #9A Ratio Rendezvous
Objective 6: Identifies percent as a ratio.	1. MAC 7, Houghton Mifflin • #11 Pie Graphics
Objective 8: Finds the percent of a number.	1. MAC 6, Houghton Mifflin • Disk B: #9

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 7
Objective 9: Expresses one number as a percent of another number.	1. MAC 8, Houghton Mifflin • #9B Pulling Percents
MEASUREMENT AND GEOMETRY	
Objective 1: Applies and practises problem-solving skills in new situations.	1. GEOMETRIC CONCEPTS: AREA, Jostens Learning 2. GEOMETRIC CONCEPTS: PERIMETER, Jostens Learning 3. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 4. GEOMETRIC SUPPOSER: QUADRILATERALS, Sunburst • Use with Geometric PreSupposer.
Objective 2: Maintains previously developed skills (concepts of linear, area, volume, capacity and mass measures in concrete, pictorial and formal forms; determines perimeter and area of right triangles and rectangles, and volumes of rectangular solids with and without formulas; uses protractor to determine the measure of an angle; transformational geometry).	1. MOTION GEOMETRY: FLOPPY MATH, Nelson 2. GEOMETRIC CONCEPTS: AREA, Jostens Learning • Disks: C and D 3. GEOMETRIC CONCEPTS: PERIMETER, Jostens Learning • Disks: A and B 4. GEOMETRIC PRESUPPOSER, POINTS AND LINES, Sunburst 5. GEOMETRIC SUPPOSER, TRIANGLES, Sunburst • Use with Geometric PreSupposer. 6. HOLTMATH 7, Holt • Disk 1; Disk 6: section 2 7. MAC 6, Houghton Mifflin • Disk C: 11, 12

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 7
Objective 7: Uses estimation and guess and test procedures to solve equations.	1. MATH SEQUENCES, Milliken • Disk: Equations
Objective 9: Given ordered pairs, plots points on a coordinate plane.	1. COORDINATE MATH, ver. 1.0, MECC • Use Nomad only. 2. HOLTMATH 7, Holt • Disk 6: section 1 only 3. NUMBER QUEST, Sunburst • Set 2; gives practice only.

Matching Software To Grade Eight Objectives

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 8
PROBLEM SOLVING	
Objective 1: Demonstrates an understanding of a problem-solving situation.	1. KING'S RULE (THE), WINGS for learning • Reviews sequences.
Objective 2: Demonstrates a willingness to find a solution to a problem.	1. KING'S RULE (THE), WINGS for learning • Reviews sequences.
Objective 3b: Uses a variety of strategies to solve problems. Making a plan.	1. KING'S RULE (THE), WINGS for learning • Reviews sequences. 2. MIND PUZZLES, ver. 1.2, MECC
Objective 3c: Uses a variety of strategies to solve problems. Carrying out the plan.	1. GEARS, Sunburst • Develops strategies. 2. KING'S RULE (THE), WINGS for learning 3. MIND PUZZLES, ver. 1.0, MECC 4. PROBLEM-SOLVING STRATEGIES, MECC
NUMBER SYSTEMS AND OPERATIONS	
A. WHOLE NUMBERS	
Objective A1: Maintains previously developed skills with whole numbers (operations, order of operations, evaluation of expressions, prime numbers, factorization, divisibility).	1. CONQUERING WHOLE NUMBERS, ver. 1.0, MECC 2. HOLTMATH 7, Holt • Disk 2: section 1 3. MAC 6, Houghton Mifflin • Disk A: 2, 3, 4 4. MATH SEQUENCES, Milliken • Disks: +, -, x, ÷, Laws of Arithmetic

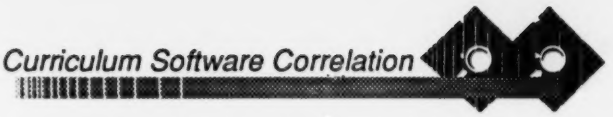
STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 8
	5. NUMBER MUNCHERS, ver. 1.0, MECC 6. POWER DRILL, Sunburst
Objective A2: Finds the greatest common factor of a given set of numbers.	1. HOLTMATH 7, Holt • Disk 2: section 1
Objective A3: Finds the lowest common multiple of a given set of numbers.	1. HOLTMATH 7, Holt • Disk 2: section 1 2. MAC 8, Houghton Mifflin • #6 Number Stomper
Objective A4: Understands and uses the terms: *exponent, base, power, squared, cubed* and the *nth power of a number.*	1. MAC 8, Houghton Mifflin • 2A Power Patterns
Objective A5: Demonstrates the need for scientific notation.	1. EXPONENTIAL NOTATION: MATH for SCIENCE SERIES, Merlan Scientific • Includes negative exponents.
Objective A6: Writes numbers in scientific notation in standard form (Limit: positive exponents.)	1. EXPONENTIAL NOTATION: MATH for SCIENCE SERIES, Merlan Scientific • Includes negative exponents.
B. INTEGERS	
Objective B1: Maintains previously developed skills with integers (need for integers, concept of integers, ordering of integers, demonstrates addition of integers with manipulatives).	1. HOLTMATH 7, Holt • Disk 5: section 1 2. MATH SEQUENCES, Milliken • Disk: Integers

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 8
Objective B3: Uses concrete manipulatives to demonstrate the subtraction, multiplication and division of integers.	1. HOLTMATH 7, Holt • Disk 5: section 2
Objective B4: Performs the operations of addition, subtraction, multiplication and division with integers.	1. ALGEBRA DRILL & PRACTICE I, Conduit • Disk 1: set 5. 2. HOLTMATH 7, Holt • Disk 5: section 1 & 2 3. INTEGERS: INTEGERS FAST FACTS, EduSoft 4. MAC 8, Houghton Mifflin • #3 Number Line Hop 5. MAC 7, Houghton Mifflin • #14 Operation Integers 6. MATH SEQUENCES, Milliken • Disk: Integers
C. RATIONAL NUMBERS	
Objective C1: Maintains previously developed skills with decimal numbers (place value, operations, ordering, rounding, order of operations).	1. CONQUERING DECIMALS (+, -), ver. 1.0, MECC 2. CONQUERING DECIMALS (x, ÷), ver. 1.0, MECC 3. DECIMAL CONCEPTS, ver. 1.0, MECC 4. MAC 6, Houghton Mifflin • Disk A: #1, Disk B: #8 Integers 5. MAC 8, Houghton Mifflin • #7 Operating on Fractions

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 8
	6. MATH SEQUENCES, Milliken • Disk: Decimals 7. NUMBER QUEST, Sunburst • Game 1: part 2
Objective C2: Maintains previously developed skills with fractional numbers (concept of a fraction, equivalent fractions, concrete operations fractions).	1. CONQUERING FRACTIONS (+, -), ver. 1.0, MECC • Set 1, 2. 2. CONQUERING FRACTIONS (x, ÷), ver. 1.0, MECC 3. FRACTION CONCEPTS, ver. 1.0, MECC 4. FRACTION MUNCHERS, ver. 1.0, MECC 5. FRACTION PRACTICE UNLIMITED, ver. 1.0, MECC 6. MATH SEQUENCES, Milliken • Disk: Fractions 7. NUMBER QUEST, Sunburst • Game 1: part 2
Objective C3: Writes the multiplicative inverse (reciprocal) of a fraction, whole number or integer.	1. CONQUERING FRACTIONS (x, ÷), ver. 1.0, MECC
Objective C4: Performs the operations of addition, subtraction, multiplication and division with fractions (Limit: positive rationals.)	1. ALGEBRA DRILL & PRACTICE I: Conduit • Disk 1: set 2. 2. CONQUERING FRACTIONS (+, -), ver. 1.0, MECC 3. CONQUERING FRACTIONS (x, ÷), ver. 1.0, MECC 4. HOLTMATH 7, Holt • Disk 3

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 8
	5. MAC 6, Houghton Mifflin • Disk B #10, Disk C #14 6. MAC 8, Houghton Mifflin • #7 Operating on Fractions 7. MATH SEQUENCES, Milliken • Disk: Fractions
MEASUREMENT AND GEOMETRY	
Objective 1: Applies and practises problem-solving skills in new situations.	1. GEOMETRIC CONCEPTS: AREA, Jostens Learning 2. GEOMETRIC CONCEPTS: PERIMETER, Jostens Learning 3. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 4. GEOMETRIC SUPPOSER: QUADRILATERALS, Sunburst • Use with Geometric PreSupposer.
Objective 2: Maintains previously developed skills (linear, area, volume, capacity and mass units of measure; uses geometric tools to measure line segments and angles and to construct geometric designs, transformational geometry).	1. GEOMETRIC CONCEPTS: AREA, Jostens Learning • Disks: A, B 2. GEOMETRIC CONCEPTS: PERIMETER, Jostens Learning • Disks: A, B 3. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 4. GEOMETRIC SUPPOSER: QUADRILATERALS: Sunburst • Use with Geometric PreSupposer. 5. GEOMETRIC SUPPOSER: TRIANGLES, Sunburst • Use with Geometric PreSupposer.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 8
	6. HOLTMATH 7, Holt • Disk 1: all sections • Disk 6: section 2 7. MAC 6, Mathematics Activities Courseware, Houghton Mifflin • Disk A, Disk B #11, Disk C #12 8. MOTION GEOMETRY: FLOPPY MATH, Nelson
Objective 3: Understands and uses the terms: *perpendicular* and *parallel lines.*	1. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 2. GEOMETRIC SUPPOSER: QUADRILATERALS, Sunburst • Use with Geometric PreSupposer. 3. GEOMETRIC SUPPOSER: TRIANGLES, Sunburst • Use with Geometric PreSupposer.
Objective 4: Draws or sketches various polygons using tools such as a computer, compass, straightedge, ruler, protractor.	1. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 2. GEOMETRIC SUPPOSER: QUADRILATERALS, Sunburst • Use with Geometric PreSupposer. 3. GEOMETRIC SUPPOSER: TRIANGLES, Sunburst • Use with Geometric PreSupposer.
Objective 5: Identifies and classifies polygons according to the number of sides (Limit: decagon.)	1. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst
Objective 6: Investigates triangles by examining attributes such as measure of angles, measure of sides and lines of symmetry.	1. HOLTMATH 7, Holt • Disk 4: section 1 2. MAC 8, Houghton Mifflin • #11 Triangle Tryouts



STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 8
Objective 7: Investigates quadrilaterals by examining attributes such as measure of sides, measure of angles, lines of symmetry and diagonals.	1. HOLTMATH 7, Holt • Disk 4: section 1 2. PROBLEM-SOLVING STRATEGIES, MECC
Objective 9: Understands and uses formulas as direct measures of the perimeter of polygons (includes regular polygons).	1. FORMULA VISION, ICCE • Use for formula development.
Objective 10: Understands and uses formulas as indirect measures of the area of polygons (triangles, all parallelograms and trapezoids).	1. MAC 7, Houghton Mifflin • #5 Metric Mysteries 2. MAC 8, Houghton Mifflin 3. MATH SEQUENCES, Milliken • Disk: Measurement Formulas
Objective 11: Performs an experiment to find value of *pi* and understands *pi* as ratio of *C/d*.	1. FORMULA VISION, ICCE • Use for formula development.
Objective 12: Understands and uses the formula $C = \pi d$ as an indirect measure of the circumference of a circle.	1. FORMULA VISION, ICCE • Use for formula development.
Objective 13: Uses the formula $A = \pi r^2$ to indirectly determine the area of a circle given its radius or diameter.	1. FORMULA VISION, ICCE • Use for formula development.
Objective 15: Understands and uses a formula as an indirect strategy for determining the volume of a right rectangular prism or a cube.	1. FORMULA VISION, ICCE • Use for formula development. 2. MATH SEQUENCES, Milliken • Disk: Measurement Formulas

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 8
DATA MANAGEMENT	
Objective 2: Maintains previously developed skills (understands the purpose of statistics; interprets data from tables and graphs; draws graphs).	1. MECC GRAPH, ver. 1.1, MECC • #1, 2
ALGEBRA	
Objective 2: Maintains previously developed skills (variable, evaluation of expressions, concepts of equality, plots on a coordinate plane).	1. HOLTMATH 7, Holt • Disk 6: section 1
Objective 3: Identifies and combines like terms.	1. MATH SEQUENCES, Milliken • Disk: Equations
Objective 4: Uses formal procedures to solve equations.	1. MATH SEQUENCES, Milliken • Disk: Equations
Objective 7: Generates a set of ordered pairs in a linear relation.	1. COORDINATE MATH, ver. 1.0, MECC
Objective 8: Given a linear relation, constructs a table of values and a graph for that relation.	1. MAC 8, Houghton Mifflin • #14 Activity Courseware Solutions: One Equation 2. NUMBER QUEST, Sunburst • Use game 2.

Matching Software To Grade Nine Objectives

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 9
PROBLEM SOLVING	
Objective 1: Demonstrates an understanding of a problem-solving situation.	1. KING'S RULE (THE), WINGS for learning
Objective 2: Demonstrates a willingness to find a solution to a problem.	1. KING'S RULE (THE), WINGS for learning
Objective 3a: Uses a variety of strategies to solve problems. Understanding the problem.	1. ALGEBRA WORD PROBLEMS III: MIXTURE, COIN & INVESTMENT, Mindscape 2. KING'S RULE (THE), WINGS for learning
Objective 3b: Uses a variety of strategies to solve problems. Making a plan.	1. ALGEBRA WORD PROBLEMS III: MIXTURE, COIN & INVESTMENT, Mindscape 2. KING'S RULE (THE), WINGS for learning 3. MIND PUZZLES, MECC
Objective 3c: Uses a variety of strategies to solve problems. Carrying out the plan.	1. ALGEBRA WORD PROBLEMS III: MIXTURE, COIN & INVESTMENT, Mindscape 2. GEARS, Sunburst • Develops strategies. 3. KING'S RULE (THE), WINGS for learning 4. MIND PUZZLES, ver. 1.1, MECC

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 9
NUMBER SYSTEMS AND OPERATIONS	
Objective 2: Uses mental computation, paper-and-pencil algorithms, estimation and calculators to perform computations.	1. CONQUERING FRACTIONS (x, ÷), ver. 1.0, MECC • Use as a review.
Objective 3: Maintains previously developed skills with whole numbers, integers, decimals and fractions (operations, ordering, relationships among systems, need for rational numbers, order of operations).	1. ALGEBRA DRILL AND PRACTICE 1, Conduit order of operations • Disk 1: set 5 (limited to operations and order of operations). 2. CONQUERING DECIMALS (x, ÷), ver. 1.0, MECC • Use as a review. 3. CONQUERING FRACTIONS (x, ÷), ver. 1.0, MECC • Use as a review. 4. DECIMAL CONCEPTS, ver. 1.0, MECC • Use as a review. 5. HOLTMATH 7, Holt • Disk 5 as a review. 6. INTEGERS/INTEGERS FAST FACTS, EduSoft 7. MATH SEQUENCES, Milliken • Disks: +, -, x, ÷, Laws of Arithmetic, Integers, Decimals 8. NUMBER QUEST, Sunburst • Game 1 9. POWER DRILL, Sunburst • Use as a review.
Objective 4: Performs the operations of addition, subtraction, multiplication, division with rational numbers.	1. ALGEBRA DRILL AND PRACTICE I, Conduit • Disk 1: set 2 (limited to positive fractions). 2. MAC 8, Houghton Mifflin • #7 Operating on Fractions

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 9
Objective 11: Writes large and small numbers in scientific notation.	1. EXPONENTIAL NOTATION: MATH for SCIENCE SERIES, Merlan Scientific • Includes negative exponents.
RATIO AND PROPORTION	
Objective 1: Applies and practises problem-solving skills in new situations.	1. CONQUERING RATIOS AND PROPORTIONS, ver. 1.0, MECC • Use for writing ratios and cross multiplication. 2. MATH SEQUENCES, Milliken • Disk: Percent
Objective 2: Maintains previously developed skills.	1. CONQUERING RATIOS AND PROPORTIONS, ver. 1.0, MECC • Use for writing ratios and cross multiplication. 2. MATH SEQUENCES, Milliken • Disk: Percent
Objective 4: Finds any one of the missing elements (value or percent) in several different applications.	1. HOLTMATH 7, Holt • Disk 4: section 2
MEASUREMENT AND GEOMETRY	
Objective 1: Applies and practises problem-solving skills in new situations.	1. GEOMETRIC CONCEPTS: AREA, Jostens Learning 2. GEOMETRIC CONCEPTS: PERIMETER, Jostens Learning 3. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 4. GEOMETRIC SUPPOSER: QUADRILATERALS, Sunburst • Use with Geometric PreSupposer.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 9
Objective 2: Maintains previously developed skills (linear, area, volume, capacity and mass unit of measure; classification of polygons; perimeter and area of polygons and the circle; volume of a right rectangular prism and cube).	1. FORMULA VISION, ICCE • Use to develop formulas. 2. GEOMETRIC CONCEPTS: AREA, Jostens Learning • Disks: C, D, E 3. GEOMETRIC CONCEPTS: PERIMETER, Jostens Learning • Disks: A, B 4. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 5. GEOMETRIC SUPPOSER: QUADRILATERALS, Sunburst • Use with Geometric PreSupposer. 6. GEOMETRIC SUPPOSER: TRIANGLES, Sunburst • Use with Geometric PreSupposer. 7. HOLTMATH 7, Holt • Disk 1 8. MATH SEQUENCES, Milliken • Disk: Measurement Formulas
Objective 4: Determines the sum of the angles in a polygon.	1. GEOMETRIC SUPPOSER: QUADRILATERALS, Sunburst • Use with Geometric PreSupposer. 2. HOLTMATH 7, Holt • Disk 4: section 1.
Objective 7: Constructs regular polygons using tools such as a computer, ruler, protractor and/or compass.	1. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 2. GEOMETRIC SUPPOSER: QUADRILATERALS, Sunburst • Use with Geometric PreSupposer.

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 9
Objective 10: Uses a compass and a straight edge to make constructions.	1. GEOMETRIC PRESUPPOSER: POINTS AND LINES, Sunburst 2. GEOMETRIC SUPPOSER; QUADRILATERALS, Sunburst • Use with Geometric PreSupposer.
Objective 13: Understands and uses a strategy for finding the surface area of any right prism or cylinder.	1. FORMULA VISION, ICCE • Use to develop formulas.
Objective 14: Understands and uses a strategy for finding the volume of any right prism or cylinder.	1. FORMULA VISION, ICCE • Use to develop formulas.
DATA MANAGEMENT	
Objective 1: Applies and practises problem-solving skills in new situations.	1. MECC GRAPH, MECC • #1, 2
Objective 2: Maintains previously developed skills.	1. MECC GRAPH, MECC • #1
Objective 7: Understands and uses the term probability.	1. MAC 7, Mathematics Activities Courseware, Houghton Mifflin • #13 Hit or Miss
Objective 8: Expresses the probability of the occurrence of an event from a practical situation or a simple experiment or simulation.	1. MAC 8, Mathematics Activities Courseware, Houghton Mifflin • #15 Probable Urn-ings

STRAND AND OBJECTIVE	MATCHING SOFTWARE FOR GRADE 9
ALGEBRA	
Objective 2: Maintains previously developed skills (variables, like terms, evaluation of expressions, solving equations, generating and plotting ordered pairs from a given relation).	1. COORDINATE MATH, MECC • Use Radar only. 2. EQUATION MATH, MECC • Use Exploring Equation only. 3. HOLTMATH 7, Holt • Disk 6: section 1.
Objective 3: Uses formal procedures to solve equations.	1. MATH SEQUENCES, Milliken • Disk: Equations
Objective 10: Given a set of ordered pairs or table of values, writes the function that determines the relation. (Limit: linear relations.)	1. MAC 7, Houghton Mifflin • #15 Connect the Points 2. MAC 8, Houghton Mifflin • #14 Equation Darts

SOFTWARE DESCRIPTIONS*

To order programs, see list of software publishers in Appendix M.

ADDITION LOGICIAN ver. 1.0, MECC (#125)

Drill and practice in whole number addition concepts involving regrouping is interspersed with motivating and challenging games. The problems are carefully sequenced according to difficulty and records are kept on individual student performance. Very user friendly. This package is a follow-up to Early Addition (#788) and Circus Math (#109) in the Mastering Math series. Disk must remain in drive.

ALGEBRA DRILL & PRACTICE 1 (Conduit)
A resource for grades 9 to 12.

This two-disk package covers fractions, percents, integers, word problems, simplification, slopes and equations of lines. Programs begin by presenting sample questions that can be accessed again if a question is answered correctly on the first or second attempt. Good content development, sound instructional design and excellent error handling combine to make this package a potentially valuable resource for classroom teachers.

This product may be purchased for US$125 (1988) from Conduit.

ALGEBRA WORD PROBLEMS III: MIXTURE, COIN & INVESTMENT (Mindscape Inc.)
A resource for grades 8 to 10.

The student is taken through a step-by-step procedure involving three stages—translation into mathematical expressions, formation of equation and solution of problem. The structured approach to solving word problems makes this appropriate for remediation. Instruction in the concepts is required before using this program.

This product may be purchased for US$39.95 (1988) from Mindscape.

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* The titles of the student learning resources identified were provided through the courtesy of Edmonton Public School Board. This listing is not to be construed as an explicit or implicit departmental approval for use. These titles are provided as a service only to assist local jurisdictions to identify resources that contain potentially useful ideas for teachers. The responsibility to evaluate these resources prior to selection rests with the local jurisdiction according to local policy.

BUMBLE GAMES (The Learning Company)
A resource for grades 1 to 4.

This is a problem-solving/game disk containing six programs designed to introduce the use of number pairs to identify positions in an array and for points on a grid.

The school edition is available for US$59.95 (1988) from The Learning Company.

BUMBLE PLOT (The Learning Company)
A resource for grades 2 to 6.

This is a problem-solving/game disk containing six programs designed to build a student's plotting and graphing skills (number lines and coordinate grid). As these involve negative numbers, the content is not appropriate for Alberta Division I students.

The educational version is available for the same price as above from The Learning Company.

CLOCKWORKS ver. 1.0, MECC (#168)

Four activities give practice in telling time using both digital and analogue formats. Students read and write time to hour, half hour, quarter hour and minute. Teacher options allow for careful selection of question. The graphics are great and sound can be turned off. Disk must remain in drive.

CODE QUEST (Sunburst Communications)
A resource for grades 4 to 7.

In this one-disk package, students are presented with up to six successive clues to help them identify a mystery object or person. The clues, written in code form, include ciphers written backward, number and alphabetic substitution, substitution of code words for a letter, transposition of ciphers using a box grid and substituting pictures for letters. The student must apply the problem-solving skills of discrimination, pattern identification, analysis, classification, sequencing, flexibility and trial and error in an attempt to solve the problem.

This product may be purchased for Can$87 (1989) from Sunburst.

COMPUTER GENERATED MATH: VOL. 1 ver. 1.3, MECC (#757)
COMPUTER GENERATED MATH: VOL. 2 ver. 1.1, MECC (#758)

Each volume generates tests and worksheets for problem solving in grades 3 to 8. Volume 1 focuses on interpreting tables, reading graphs and working backward. Volume 2 includes approximation/estimation, purchasing, money and division/multiplication. One evaluator pointed out that test cannot be viewed on the screen before printing. Another noted that the questions might be too difficult for elementary school children. Printer required. Disk must remain in drive.

CONQUERING DECIMALS (+, -) ver. 1.0, MECC (#207)
CONQUERING DECIMALS (x, ÷) ver. 1.0, MECC (#208)

Conquering Decimals provides drill and practice in operations involving decimals. The student is encouraged to estimate the answer, which can be compared to the calculated answer. Although the drill is well designed, it can become tedious. Fortunately, motivating games are also introduced.

The teacher may wish to use the programs in a group setting to introduce operations with decimals as well as use it later in the instructional sequence to reinforce concepts. Students' scores are saved to disk.

CONQUERING FRACTIONS (+, -) ver. 1.0, MECC (#204)

Students practise addition and subraction of fractions in this tutorial/drill program. Two games, "Fraction Chompers" and "Fraction Dash," reinforce learning and motivate students to learn the facts to develop winning strategies.

CONQUERING FRACTIONS (x, ÷) ver. 1.0, MECC (#205)

Two games, "Fraction Chompers" and "What's My Fraction?", provide motivating drills in multiplying and dividing fractions. They lend themselves to settings in which students work in pairs or individually at a computer centre. Students' scores are saved to disk.

CONQUERING MATH WORKSHEET GENERATOR ver. 1.0, MECC (#260)

Teacher utility that generates worksheets based on objectives (Conquering Math series objectives). Allows selection of specific objectives and number of problems on each worksheet.

CONQUERING PERCENTS ver. 1.0, MECC (#210)

This program gives students an opportunity to work with percents in a variety of ways. The program "Percent Factory" visually introduces the concept of a percent. In a factory setting, students must either guess the percent of a circle or rectangle that is painted or paint a given percent of a shape. The program "Everything's on Sale" provides students with practice in setting up and solving percent problems to find the original prices, discounts and discount rates of various items. Teacher options are provided to allow you to regulate the number and types of problems available to students, control access to the game, control use of an on-screen calculator and view and print records of student performance.

CONQUERING RATIOS AND PROPORTIONS ver. 1.0, MECC (#209)

This program gives students an opportunity to work with ratios and proportions in a variety of ways. The program emphasizes many of the introductory concepts associated with understanding ratios. Included are creating and identifying ratios, finding decimal and percent equivalents, and forming ratios by selecting appropriate information from tables of data. The "Proportions" program provides students with practice in setting up proportions and solving proportion word problems. Teacher options are provided to allow you to regulate the problem types available to students, to control the use of unit rate and to view and print records of student performance.

CONQUERING WHOLE NUMBERS ver. 1.0, MECC (#201)

Drill and practice in all four basic operations using multiple digits and regrouping. Intermediate steps are allowed and shown on the screen (regrouping). Three games, "Bagels," "Tax Collector" and "Bowling," provide motivating and challenging practice in problem solving, factoring skills and mental arithmetic. The first two games are updated versions.

A management system with a capacity of 75 is included. It allows the teacher to change problem settings, change "regroup" phrase, see, print or delete students' results. The program is user friendly and easy to implement.

COORDINATE MATH ver. 1.0, MECC (#192)

Contains three programs in game format that provide drill and practice using the Cartesian coordinate system. "Nomad" uses a map and grid to find a destination. "Snark" has three levels of difficulty and uses any of the four quadrants. It requires the student to find a hidden object on a grid using circular searches. "Radar" is a simulation in which users direct a boat to meet a ship. It has two levels of difficulty—one using degrees, the other using coordinates.

Options allow the teacher to select the type of coordinate system or allow the student to choose. There are two types: graph coordinates (number – number) and map coordinates (letter – number).

DECIMAL CONCEPTS ver. 1.0, MECC (#206)

This program gives students an opportunity to work with decimal numbers in a variety of ways. The programs emphasize many of the introductory topics associated with decimal numbers. Included are the topics of place value, comparing and ordering decimal numbers, rounding decimal numbers and comparing decimal numbers to common fractions. The models used in the programs to represent decimal numbers include the common applications of time and distance, the unit decimal square and the number line.

EASY GRAPH (Grolier Electronic Publishing Inc.)

A computer graphing tool that teaches how to read, understand and make graphs—pictographs, bar graphs and pie charts. An excellent teacher demonstration tool for grades 1 to 4. Can be used by students in grades 5 and 6 after teacher introduction. Great potential with teacher introduction and with teacher-designed examples. Printer required for hard copy. Disk must remain in drive. (Back-up disk is included if "School Version" is purchased.)

This product may be purchased for Can$60 (1988) from Grolier.

ELEMENTARY MATHEMATICS VOLUME 1, MECC (#702)

Eleven programs on this disk provide practice in estimating, rounding, factoring, logic, converting metric lengths and making change. Evaluators noted that although the content is appropriate for Division II mathematics, some programs are more useful than others. One evaluator believed that the program was rather boring. The two positive evaluators found that, for the price, parts of the program would be useful as a support resource. Disk must remain in drive.

EQUATION MATH ver. 1.1, MECC (#193)

Contains three programs that explore linear, quadratic and trigonometric equations on a coordinate or polar grid. It provides an exploratory tool that reduces the time-consuming aspects of plotting and graphing and presents abstract relationships in a visual form. Students may benefit from a demonstration by the teacher before using the program. Graphs can be printed. This program is a companion to Coordinate Math.

ESTIMATION ver. 1.1, MECC (#124)

Four programs deal with estimation on a number line as well as by intelligent calculation. Although the evaluators stressed that the software should not be used for initial instruction in estimation, it was agreed that the disk would be useful for practising the skill and for enrichment. The design is clear and inviting. Disk must remain in drive.

EXPONENTIAL NOTATION (Merlan Scientific Ltd.)
A resource for grades 7 to 12.

This disk contains three programs covering scientific notation and the addition, subtraction, multiplication and division of numbers written using scientific notation. The programs consist of lessons and drills. Active, meaningful interaction combined with a well-designed feedback system that effectively diagnoses a wide variety of student deficiencies make this disk a useful classroom teaching aid.

This disk is part of the "Math for Science" series: (4 disks total). Each disk can be purchased for US$35 (1988) from Merlan Scientific Ltd.

FACTORY (THE) (WINGS for learning)
A resource for grades 4 to 9.

This program promotes problem solving using the concepts of sequence, rotation, visual discrimination, spatial perception and logic. Students attempt to duplicate the results of a series of machines that may rotate, punch holes or draw stripes at three levels of difficulty.

The one disk is available from WINGS for learning for Can$87 (1989).

FORMULA VISION (Gentleware Corp.)

An easy-to-use spreadsheet, designed specifically for a low-level introduction to the idea of a spreadsheet and its possible uses in working with formulas. There are only 15 cells in this spreadsheet, which fills the Apple screen. Each cell has three categories: name, numerical unit and unit of measure.

The purchase price for a classroom site licence is US$29.95 (1989) from ICCE/ISTE.

FRACTION CONCEPTS INC. ver. 1.0, MECC (#202)

Introduces students to beginning fraction concepts such as the basic definition of a fraction, different types of fractional numbers, simple equalities and the roles of the numerator and denominator. Teacher options permit the teacher to adjust the content and view students' results. These may be printed.

This program is suitable for introduction at the Grade 3 level and review and remediation in grades 4 and 5. More instruction for the introduction of fraction concepts and more corrective feedback would strengthen this program.

FRACTION FACTORY (Springboard Software)
A resource for grades 3 to 6.

The program offers drill and practice in five different areas: finding fractions of a set, finding equivalent fractions, finding fractions of a number, adding fractions and subtracting fractions. The program effectively uses graphics, colour, sound and incremental prompts to convey instructional concepts.

The single disk package may be purchased for US$29.95 from Springboard.

FRACTION MUNCHERS ver. 1.0, MECC (#196)

This disk contains four educational games, which provide practice in equivalent, proper, improper, reduced and other types of fractions. The content is probably most appropriate for grades 4 to 6. The game format is motivational. Management options are effective and allow the teacher to select which games the students will use, to set the game parameters and to erase the "Hall of Fame" lists. Sound may turned on or off during a game. The use of a joystick is optional. When using the Apple //gs, the system speed should be set at normal for best results.

FRACTION PRACTICE UNLIMITED ver. 1.0, MECC (#203)

A game approach provides four drill and practice programs in a variety of skills associated with fractional numbers, such as classifying, reducing and renaming various types of fractions. The content, number of questions, speed and difficulty level can be adjusted using Teacher Options, but the teacher cannot add data. Students' results and a listing of the skills can be printed.

The program is easy to use and provides motivating practice in previously taught concepts, but the feedback is weak in most of the games and too many errors are permitted before assistance is given.

GEARS (Sunburst Communications)
A resource for grades 7 to 9.

The three programs on this disk are designed to promote a student's acquisition of problem-solving skills through experimentation with the properties of gears. The program puts students into situations where they have to analyze a problem to identify a solution and discover mathematical formulas or build a model that will help predict an outcome. The program is also intended to increase skills in the division of decimal numbers.

This product is available for Can$87 (1989) from Sunburst.

GEOMETRIC CONCEPTS - AREA (Jostens Learning Systems)
A resource for grades 5 to 9.

This package contains three disks, each of which has six instruction units, four review units and two test units on the areas of rectangles, squares, parallelograms and triangles. Good incremental sequencing, along with automatically involved review sessions for students having difficulty, provides sound educational design.

The package may be purchased for US$120 (1988) from Jostens.

GEOMETRIC CONCEPTS - PERIMETER (Jostens Learning Systems)
A resource for grades 5 to 9.

This package contains two disks, each of which has six instructional units, four review units and two test units on the perimeter of rectangles, squares, parallelograms and triangles. Good incremental sequencing, along with automatically involved review sessions for students having difficulty, provides sound educational design.

This package may be purchased for US$80 (1988) from Jostens.

GEOMETRIC PRESUPPOSER (THE) - POINT & LINES (Sunburst Communications)
A resource for grades 5 to 9.

This program is a utility package that gives students an opportunity to recognize geometric shapes by observation and construction. The students can execute constructions involving points, angles, segments, triangles, quadrilaterals, polygons and circles. Measurements can be made of lengths, angles, areas, circumferences and combinations of these measures. The user needs a basic knowledge of geometry as no instruction is provided on the disk. The teacher's guide is comprehensive and suggests the teacher be prepared to do careful planning in order to use this program effectively.

The product is available for US$132 (1989) from Sunburst Communications.

GEOMETRIC SUPPOSER (THE) - QUADRILATERALS (Sunburst Communications)
A resource for grades 7 to 9.

This program is a utility package for users to experiment with quadrilateral construction. Students can construct geometric forms including quadrilaterals (parallelograms, trapezoids, kites, etc.) as well as draw perpendiculars, segments, parallels, angle bisectors and inscribed and circumscribed circles. Measurements can then be made on these forms. The student needs a basic knowledge of geometry since no instruction is given on the disk. The documentation is comprehensive and is an important part of the overall package. Teachers are encouraged to become familiar with the program before using it with students.

This package is available for US$132 (1989) from Sunburst Communications.

GEOMETRIC SUPPOSER (THE) - TRIANGLES (Sunburst Communications)
A resource for grades 4 to 10.

This program offers endless opportunities for users to explore geometric constructions and theorems relating to triangles. The program does not instruct per se, rather it operates as a creative tool by which the students can explore geometric constructions and make conjectures concerning the validity of various theorems. Successful use of the program depends on careful and thorough teacher preparation and instruction. However, this program provides a powerful tool, not available through other media, that can be used effectively in a discovery approach to learning geometric concepts.

This product may be purchased from Sunburst Communications for US$132 (1989).

GERTRUDE'S PUZZLES (The Learning Company)
A resource for grades 1+.

This is a problem-solving program where students solve three types of puzzles each involving two levels of difficulty. Puzzles involve manipulating shapes to discover rules and to solve problems.

The school edition is available for US$59.95 (1988) from The Learning Company.

GUESSING AND THINKING ver. 1.0, MECC (#778)

Originally in "MECC Elementary Vol. 1," but now modified to serve the needs of hearing-impaired students. The language structure has been simplified and the presentation of material has a more guided approach. "Bagels" and "Number" are number guessing games intended to sharpen logic skills. "Hurkle" teaches students how to locate points on a number line or grid. Disk must remain in drive.

HOLTMATH 7 (Holt, Rinehart and Winston)

Twelve programs (six disks) designed to support and extend the concepts in the Holtmath 7 text. A textbook lesson can be followed by any or all of the corresponding software components or blackline master activities. The format provides for instruction followed by practice and application. The package includes good graphic/concrete displays of difficult/abstract concepts.

Available from Holt, Rinehart and Winston.

IN SEARCH OF WARGO ZANDAR III & IV: (Society for Visual Education)
A resource for grades 4 to 6.

This program is designed to motivate students to practise thinking skills, to tutor students in a logical reasoning process that will find an "unknown" containing two elements and to challenge students to apply the logical reasoning process in a game format.

This two-disk package is available for Can$104 from School Services of Canada.

INTEGERS/INTEGERS FAST FACTS (EduSoft)
A resource for grades 4 to 6.

Instruction and drill are provided in integer addition, subtraction, mixed addition and subtraction, multiplication, division, or an assortment of all operations. In "Integers Fast Facts," time drill on integer operations is given. The wide range of operations, the use of number lines and excellent negative feedback make this disk appropriate for a range of abilities.

The one-disk product is available for US$34.95 (1988) from EduSoft.

JENNY'S JOURNEYS ver. 1.0, MECC (#161)

Students can take a journey with Jenny around Lake City by reading and using maps. Three progressively challenging programs involve grid systems, translating map symbols into visual clues and using cardinal directions. Clear instructions and good graphics make this a rich supplement to map skills instruction. Disk must remain in drive.

KING'S RULE (THE): MATHEMATICS AND DISCOVERY (WINGS for learning)
A resource for grades 4 to 9.

This problem-solving program, written in a fantasy game format, allows a student to advance through a castle by successfully generating and testing hypotheses at six levels of difficulty. At each level, students are shown three numbers that correspond to a secret mathematical rule. Students must generate an hypothesis about the rule and test it by entering their own sets of numbers. The game format proves motivating and is effective in developing critical thinking skills.

This single-disk program is available for US$85 (1989) from WINGS for learning.

LOGOWRITER (L.C.S.I.)

LogoWriter combines the turtle graphics and list processing of Logo with a simple word processor. Simple disk handling and printing make this version of Logo the best one for elementary schools in 1988.

The site licence for LogoWriter allows the school to make unlimited working copies forever in four formats: Apple II, Commodore 64, IBM PC, PBM PCjr. This resource is available from the Learning Resources Distributing Centre.

MAC (Math Activities Courseware) 1, 2, 3, 4, 5, 6, 7 AND 8 (Houghton Mifflin)
A resource for grades 1 to 8.

These are separate products; each is a series of puzzles, games and activities intended to supplement the Houghton Mifflin math text for that grade. Activities may be completed individually or in groups. The courseware is designed to engage students in active experiences involving counting, ordering numbers, place value, operations with whole numbers, decimals, fractions, estimation, problem-solving strategies and concept development. The game format and group activity approach provide motivation.

All packages are available from the Learning Resources Distributing Centre. The cost is Can$155.25 each.

MASTERING MATH DIAGNOSTIC SYSTEM, MECC (#149)

This utility package helps the teacher establish where students fit into the Mastering Math series by providing tests involving operations of the teacher's choice. Students take tests on the computer, then the program reports results and recommends a starting activity in the series. Disk must remain in drive.

MASTERING MATH WORKSHEET GENERATOR, MECC (#151)

This component of the Mastering Math series can generate up to 20 worksheets containing 15 to 40 questions on specific, teacher-selected objectives. Worksheets may be personalized with students' names. Answer keys may also be printed. Disk must remain in drive.

MATH BLASTER (Davidson & Associates)
A resource for elementary grades.

The five programs on this disk provide drill and practice in operations with whole numbers and fractional, decimal and percentage equivalency. Each operation is divided into five levels of difficulty and involves demonstrations, drills and games.

This single-disk package may be purchased for US$49.95 (1988) from Davidson & Associates.

MATH SEQUENCES (Milliken Publishing Company)
A resource for elementary and junior high.

This managed math drill and practice covers operations with whole numbers, fractions, decimals and integers as well as units on percents, number readiness, equations and measurement formulas. Students proceed in very small steps through sequenced levels. Class and student reports are available from the management system.

The revised 16-disk package is available for Can$588 (1988) from the Learning Resources Distributing Centre.

MECC GRAPH ver. 1.1, MECC (#137)

Graphing utility for students to create line, bar and pie charts. Students can change their data and adjust the scale of their graphs. Can also be used for teacher demonstration. A companion to the MECC Graphing Primer (not approved). Although easy to use, a significant amount of teacher time is required to try all the options and prepare lessons. Data can be saved on a separate data disk. Graphs may be printed on some printers.

MEMORY: A FIRST STEP IN PROBLEM SOLVING (Sunburst Communications)
A resource for grades 1 to 6.

This learning package contains 10 disks designed to improve memory and retrieval strategies. Ten specific memorization skills and strategies are presented: sequence, number of items to remember, auditory aids, regrouping, personalization, creating a context, self-testing, whole to part, visual association and mnemonic systems. A 322-page teacher resource book provides extensive support for the teacher. The major strength of the package is the provision of an overall strategy and strong teacher support. The computer materials themselves serve only an ancillary role.

The package comes in three possible configurations (all figures are 1989 prices): Package A (disks #1-4 for grades 1-2) for Can$240, Package B (disks #1-7 for K-Grade 4) for Can$333 and Package C (the full package) for Can$399. All available from Sunburst.

MIND PUZZLES ver. 1.2, MECC (#780)

Two games help students develop and practise problem-solving strategies and techniques. "Mazes of Rodentia" presents a number of mazes that must be negotiated. A variety of aids is offered and the fewer the moves the higher the score. "Queen Bee of Menta" challenges students to break a secret code by manipulating a set of symbols that control borders, movements, formations and sounds. The fewer the tries, the higher the score. Incorporates many different elements of the curriculum and encourages students to think and draw conclusions that are uniquely theirs. Disk must remain in drive.

MONEY WORKS ver. 1.0, MECC (#195)

Teaches students the basics of money handling and counting by a series of drills and practice exercises. Recognizing and counting money, making purchases, counting change and designing and printing currency are the skills included. To clarify the graphics a colour monitor is essential.

MOPTOWN HOTEL (The Learning Company)
A resource for grades 2 to 4.

This disk contains seven progressively ordered games designed to develop logic skills of recognizing analogies, completing closed sequences, identifying unique features, understanding negation, formulating and testing hypotheses and planning. Active student involvement promotes motivation in each game. A colour monitor is necessary for classroom use.

The educational version consists of two copies of the disk along with extensive teacher documentation containing suggested on-line and off-line activities in blackline master form. It is available for Can$79.95 (1988) from the Learning Resources Distributing Centre.

MOPTOWN PARADE (The Learning Company)
A resource for grades 1 to 3.

This disk contains seven progressively ordered games designed to develop logic skills of identifying similarities and differences in figures, recognizing sequence patterns, identifying attributes by which a cluster of figures is grouped and developing a language sequence of three adjectives followed by a noun. It is intended to precede "Moptown Hotel." Active student involvement promotes motivation in each game. A colour monitor is necessary for classroom use.

The educational version consists of two copies of the disk along with extensive teacher documentation containing suggested on-line and off-line activities in blackline master form. It is available for Can$79.95 (1988) from the Learning Resources Distributing Centre.

MOTION GEOMETRY: FLOPPY MATH (Nelson Canada Ltd.)
A resource for grades 7 to 9.

The objective of this program is to provide students with practice in applying the concepts of motion geometry using slides, flips and turns to a decision-making setting in which outcomes can be predicted and confirmed. Four programs provide the student with a demonstration, a practice session, a drill requiring strategy and a timed drill.

This single-disk product may be purchased for Can$99.95 (1988) from Nelson Canada Ltd.

MULTIPLICATION PUZZLES ver. 1.0, MECC (#147)

A series of five programs with increasing levels of difficulty on whole number multiplication. Each level ends with a game that emphasizes logic and problem-solving skills. The teacher can control activity access by using the Mastering Math management system. Good graphics. Disk must remain in drive.

NUMBER MUNCHERS ver. 1.0, MECC (#170)

Drill and practice on basic facts includes: identification of multiples, factors, sums, differences, products, dividends, prime numbers, as well as concepts of equality and inequality. Skills are presented in a game format. The program is motivating and modifiable. Disk must remain in drive.

NUMBER QUEST (Sunburst Communications)
A resource for grades 7 to 9.

This disk provides five programs that enable a student to use binary search strategies to find whole numbers, fractions and decimals. The program helps the student understand the order properties of integers, fractions, ordered pairs and ordered triplets.

This single-disk package may be purchased for Can$87 (1989) from Sunburst.

PATH TACTICS ver. 1.1, MECC (#162)

Students attempt to beat opponents or the computer through a maze that presents drill on basic math facts. Strategy can be applied to find the shortest path through the maze. Although a tutorial is included, the reading level may be inappropriate for young children. The game format is very motivating. Disk must remain in drive.

POWER DRILL (Sunburst Communications)
A resource for grades 7 to 9.

This program deals with the estimation of whole numbers and offers four drill programs using the operations of addition, subtraction, multiplication and division. The program helps students gain facility in estimating the results of mathematical computations, enables students to gain proficiency in mental arithmetic and assists students to develop strategies to redo difficult problems in simpler forms. The program also helps students explore patterns in numbers and their operations.

This program may be purchased for Can$87 (1989) from Sunburst.

PROBLEM-SOLVING STRATEGIES, MECC (#784R)

A disk with four programs for teaching problem-solving strategies. The three strategies presented are "guess and check," "exhaustive listing" and "simplifying the problem." Students practise collecting data, creating charts and looking for patterns as they apply these strategies.

The programs could be effectively used with the whole class at once using a demonstration computer. Teacher-led discussion would enrich the computer experience.

QUOTIENT QUEST ver. 1.0, MECC (#148)

Division facts— two- or three-digit dividends with one digit divisors—are presented in increasing difficulty in drill and practice format. Successful completion of drill allows the student to play one of five challenging games. Documentation is very helpful in selecting appropriate activities. Use of this program with the Mastering Math series is a bonus. Disk must remain in drive.

ROCKY'S BOOTS (The Learning Company)
A resource for grades 3 to 6.

In this game activity program, students aged nine and up can learn to logically analyse and build simple electronic circuits using components that are commonly found in digital computers. Students proceed through six sequential activities and may choose additional practice at any point.

This product may be purchased for US$87 (1989) from The Learning Company.

SAFARI SEARCH (WINGS for learning)
A resource for grades 2 to 6.

This program is designed to assist students to construct complex mathematical thinking patterns; to provide an arena in which students invent and extend problem-solving tactics; to call on students to collect, organize and use information; to provide an arena in which students learn that their own thinking is important; and to enable students to work collaboratively and to enjoy themselves while doing so.

This product may be purchased for US$85 (1990) from WINGS for learning.

SPEEDWAY MATH ver. 1.0, MECC (#169)

Three programs are designed to give practice in quick recall of basic math facts: sum and minuends to 18; factors and divisors to 12. The program provides an opportunity for students to recognize errors and to improve speed. Teachers can use a management system to determine the difficulty of questions and to record student progress. The program is motivating, well paced and easy to use. Disk must remain in drive.

SUPER FACTORY (THE) (WINGS for learning)
A resource for grades 5 to 6.

This program is designed to provide students with an environment in which they can manipulate and become familiar with the properties of a three-dimensional cube; to teach students the four steps of problem solving; and to provide students with a way of approaching and tackling a problem through classroom lessons.

This package is available for US$85 (1990) from WINGS for learning.

TEASERS BY TOBBS (WINGS for learning)

Two programs give students practice in logically solving addition and multiplication problems. The games are in the shape of an addition or multiplication grid. The grid presents a series of math problems, each missing a number. Students decide which number cannot be, might be or must be the correct solution.

This product may be purchased for US$85 (1990) from WINGS for learning.

TONK IN THE LAND OF BUDDY BOTS (Mindscape Inc.)
A resource for grades 1 to 3.

This program is designed to refine and reinforce visual discrimination, problem solving and critical thinking skills. In addition, the program includes multiple levels of involvement, comprehension, application analysis, synthesis and evaluation. The motivational approach, using colour and graphics, provides an enjoyable learning experience.

A weakness in the program is the lack of accommodation of non-readers; as a result, someone who can read must provide introductory help. Some activities may be too challenging for the young target audience.

This product may be purchased for US$19.95 from Mindscape.

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Appendix B – Computer Integration Form	A-5
Appendix C – Elements of Effective Lesson Planning	A-7
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Appendix E – Cutout Cube Sheet 2	A-11
Appendix F – Activity Sheet 1	A-13
Appendix G – Activity Sheet 2	A-15
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Appendix J – Design Table 1	A-21
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Software Evaluation *

All software used in the classroom should be evaluated before use. This should be done by either Alberta Education's Curriculum Branch, local school boards or individual teachers.

To assist individual teachers in their evaluation, the accompanying checklist is provided. In this case, all four of the criteria under Educational Content should be met and as many of the remaining criteria as possible. The larger the latter group of criteria, the simpler the program should be to use. However, this is left to the individual teacher's discretion.

Software Evaluation Checklist

Educational Content

1. Content is accurate and meets with the learner expectations of Alberta Education curriculum _____
2. Content is free of bias, prejudice, intolerance and stereotyping. _____
3. Content (including difficulty and reading levels) is appropriate for intended users. _____
4. Content is presented in an interesting manner. _____
5. Content is presented in a manner consistent with the philosophy of the program. _____

Presentation

6. Directions are clear and easy to follow. _____
7. Methods of interaction are consistent. _____
8. Content is presented in small incremental steps from easy to more difficult. _____
9. On-screen assistance is provided (tutorial, help-screen, etc.). _____
10. Feedback is appropriate, effective and varied. _____
11. User has control over all or parts of the program. _____
12. Can be adapted to a variety of classroom situations and skill levels. _____
13. Students can access menu to change activities. _____
14. User inputs can be easily corrected (does not crash when wrong key pressed). _____

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* This information is copied from *Junior High Computer Studies Teacher Resource Manual*. Alberta Education, 1990.

15. The presentation takes advantage of the attributes of a computer. _____

Technical Design

16. Screen displays are well designed and easy to read. _____
17. Is free of errors in grammar, spelling and punctuation. _____
18. Is reliable and technically sound. _____
19. Documentation is clear and complete _____
20. Student can work with minimal teacher supervision. _____
21. Provides support material (student assignments, workbooks,etc.). _____
22. Management is flexible and easy to use. _____
23. Provides back-up copies (or can be made). _____

Management Options

24. Has record keeping capabilities. _____
25. Some means of evaluation is included. _____
26. There is a management component/option allowing teacher authoring (skill level, questions added, etc.). _____

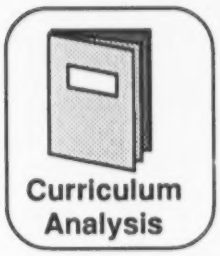
Possible Uses

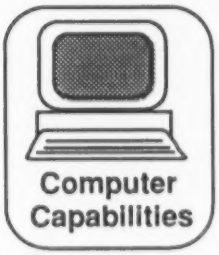
To present new information _____ To motivate _____
To provide guided practice _____ To enrich _____
To provide self-directed practice _____
To provide some tyupe of evaluation _____

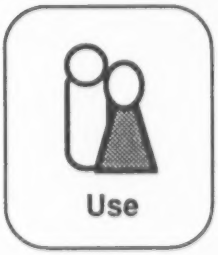
Overall Evaluation

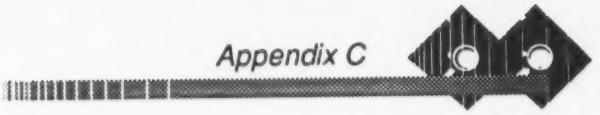
Excellent _____ Good _____ Adequate _____ Poor _____

Computer Integration Form









ELEMENTS OF EFFECTIVE LESSON PLANNING

Grade/Level:

Strand:

Learner Expectation:
(Objective)

Clarification of Expectation/Description

Teaching Tips

Teacher Preparation

Student Preparation

Resources

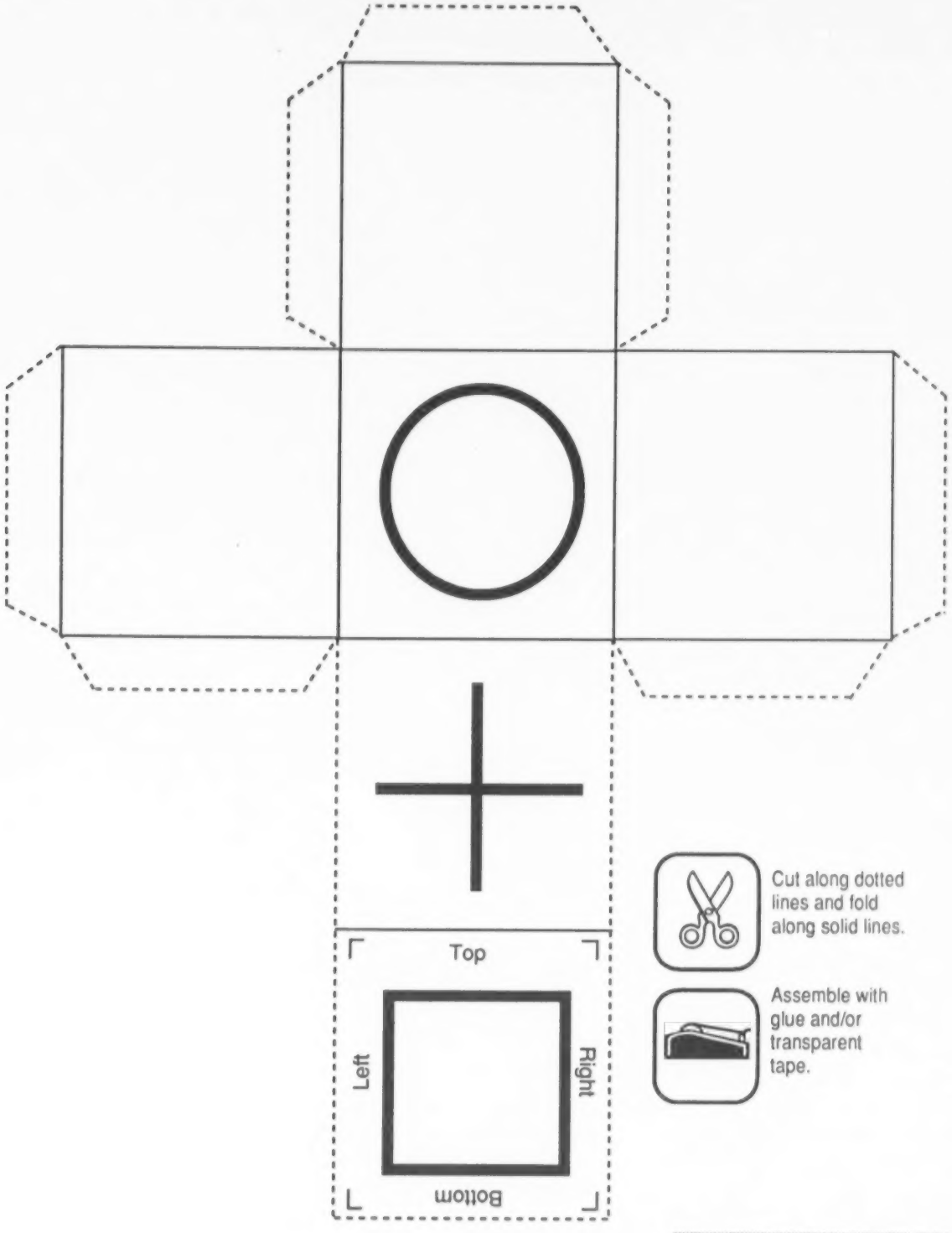
Suggested Activities

Evaluation

Elective Suggestions

Post-Lesson Comments

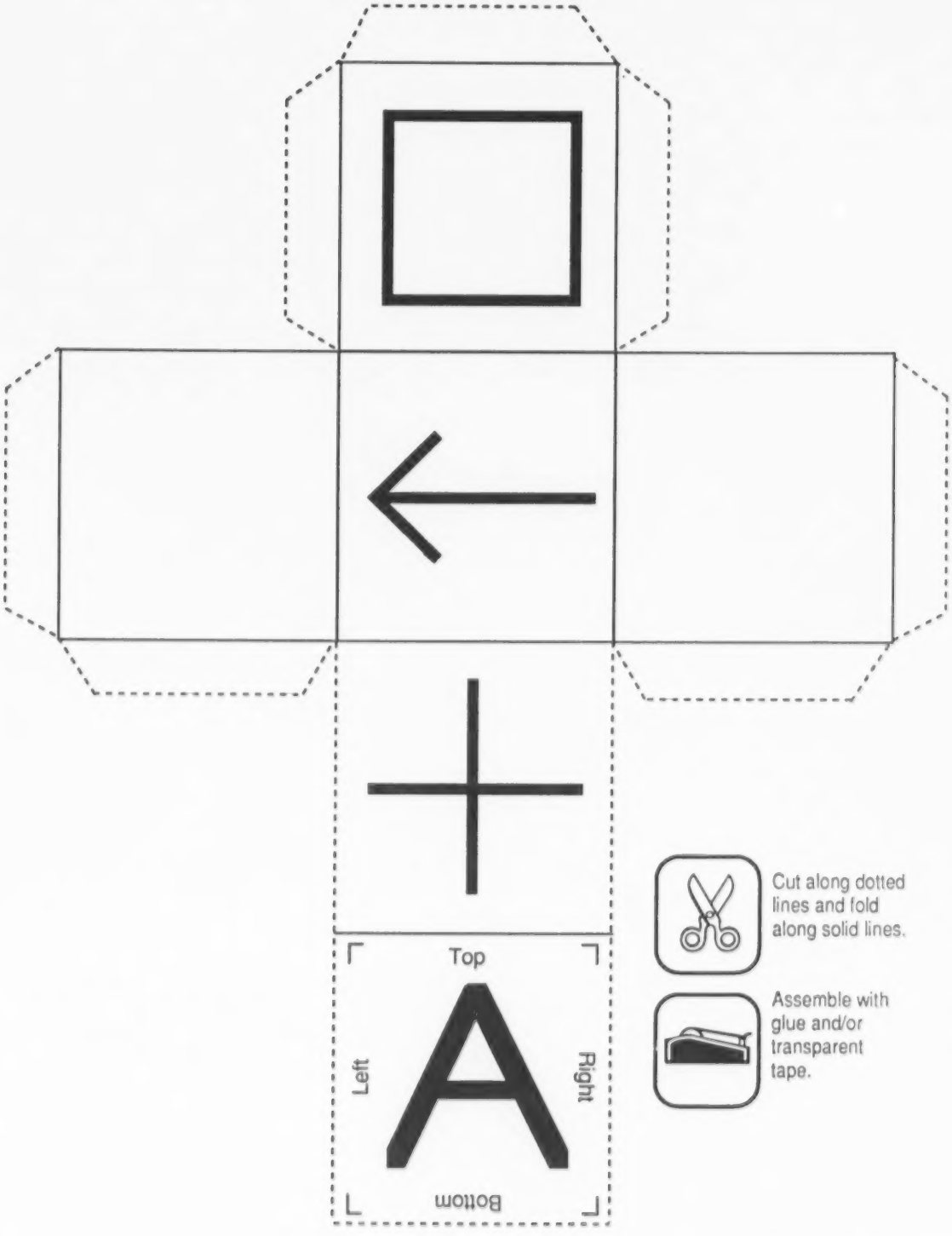
Cutout Cube Sheet 1



Cut along dotted lines and fold along solid lines.

Assemble with glue and/or transparent tape.

Cutout Cube Sheet 2

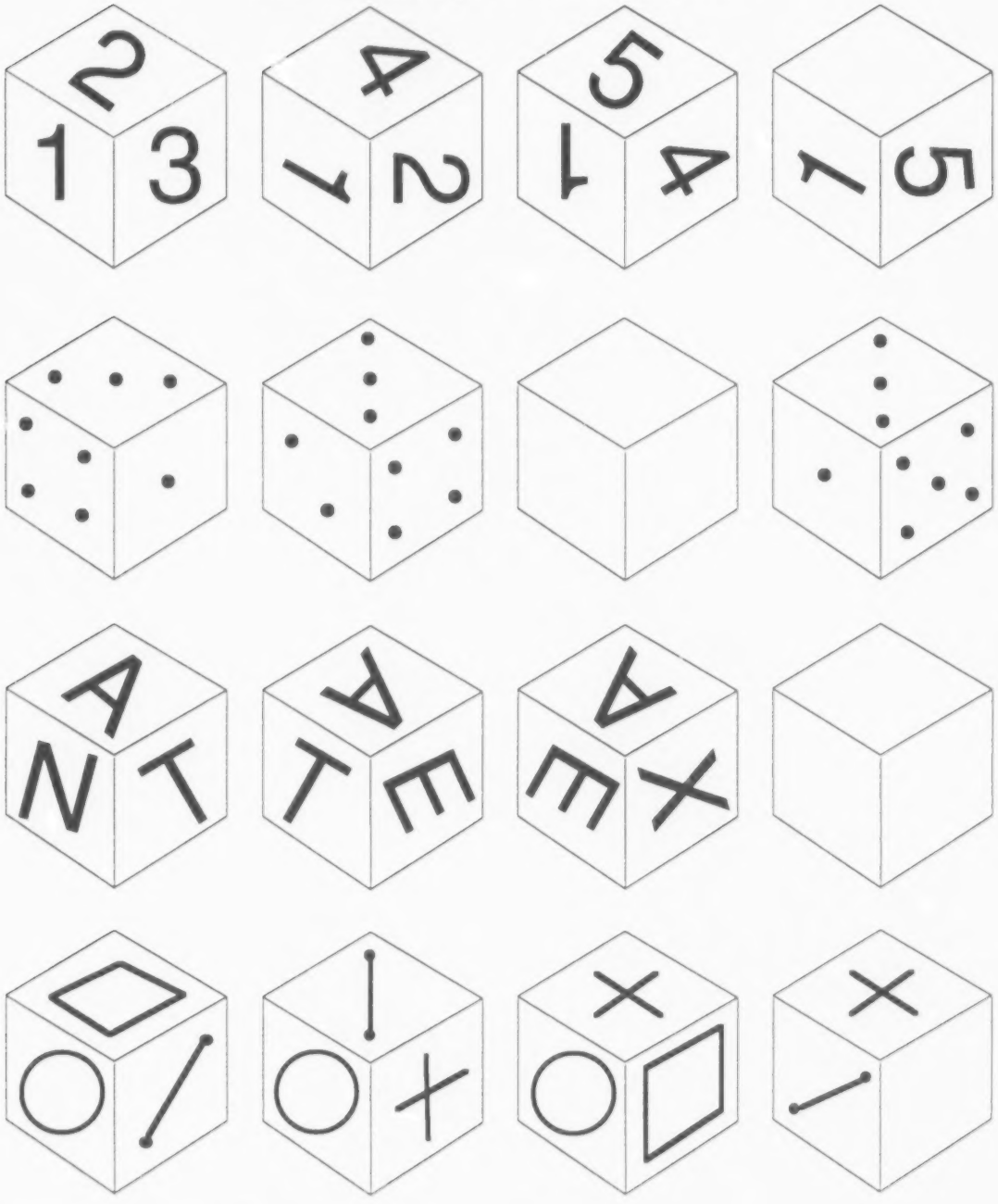


Cut along dotted lines and fold along solid lines.

Assemble with glue and/or transparent tape.

Activity Sheet 1*

Draw the correct pictures in the sequence



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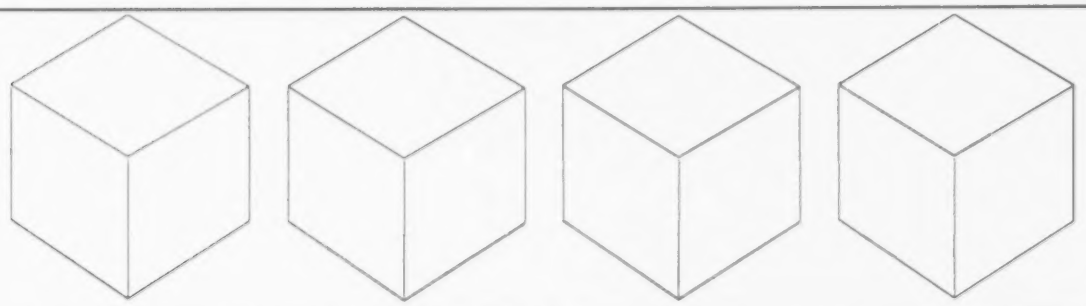
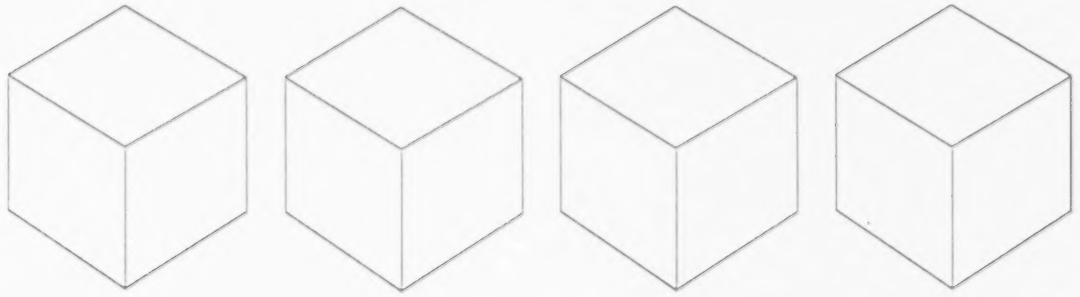
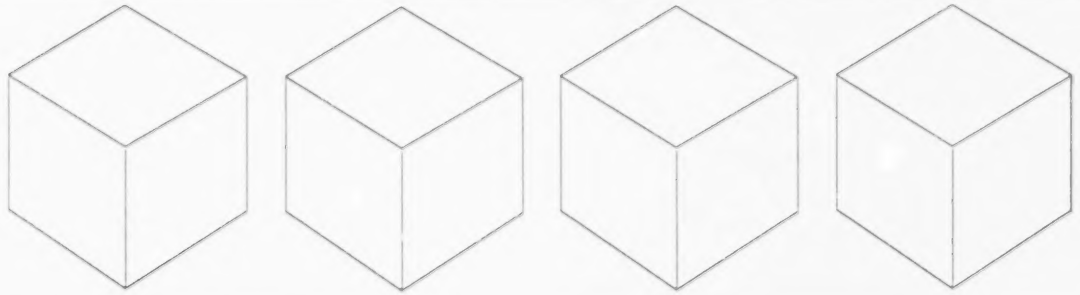
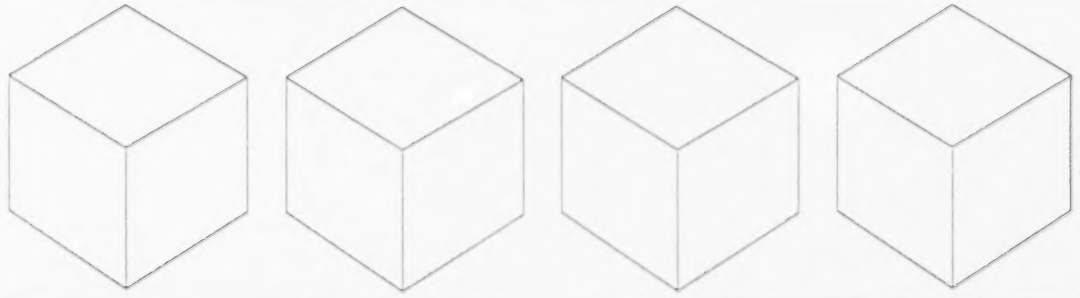
* Adapted with permission from *The Super Factory Teacher's Guide*. WINGS for learning, ©1990.

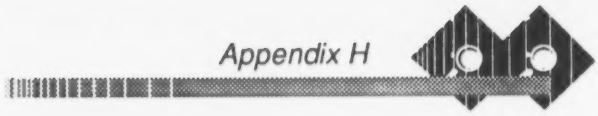
Activity Sheet 2

A 

B 

C 

D 



POLYA'S MODEL

Name: _____ Date: _____

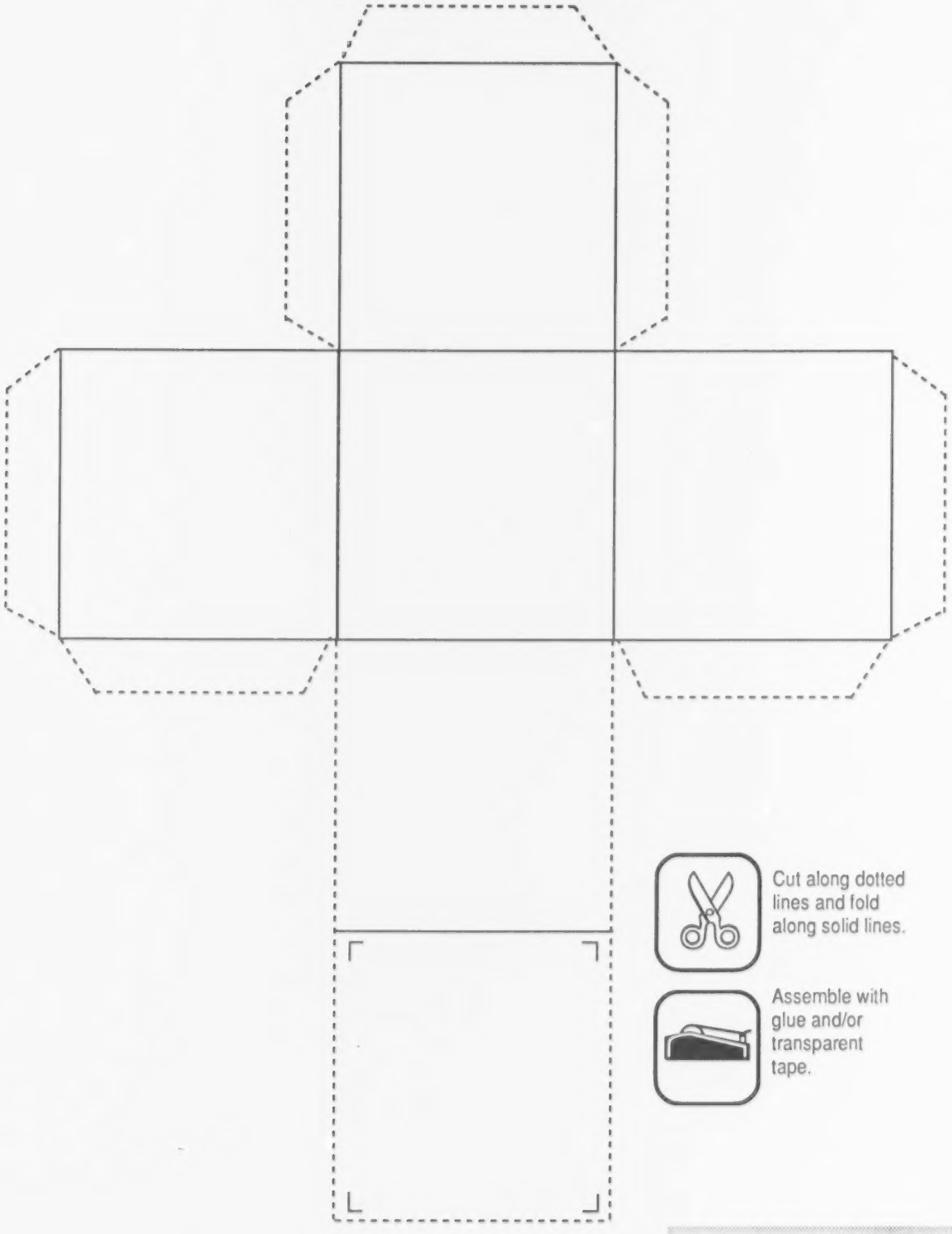
Understanding the Problem

Making a Plan

Carrying Out the Plan

Looking Back

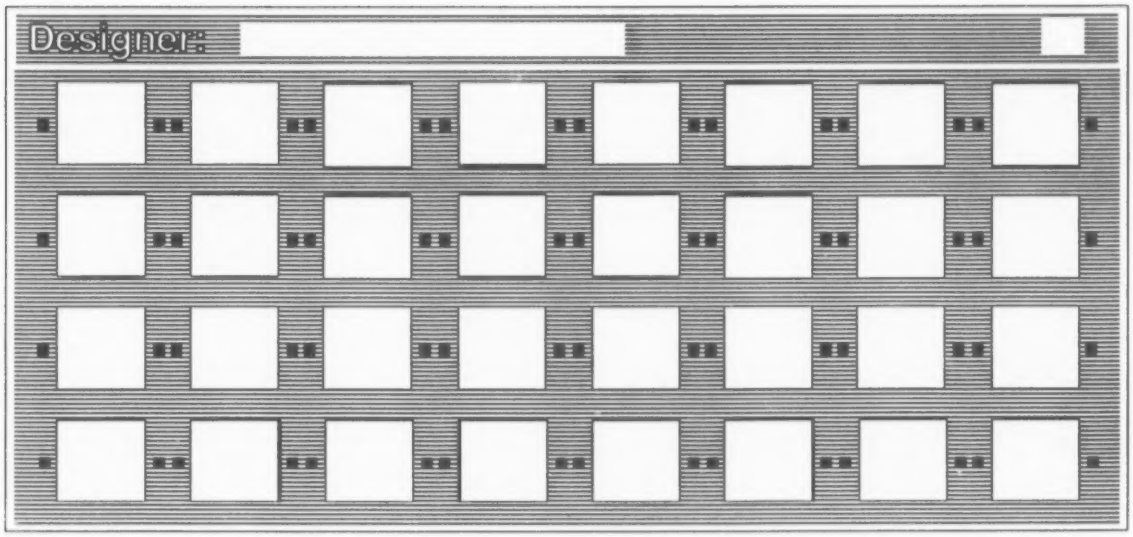
Cutout Cube Sheet 3

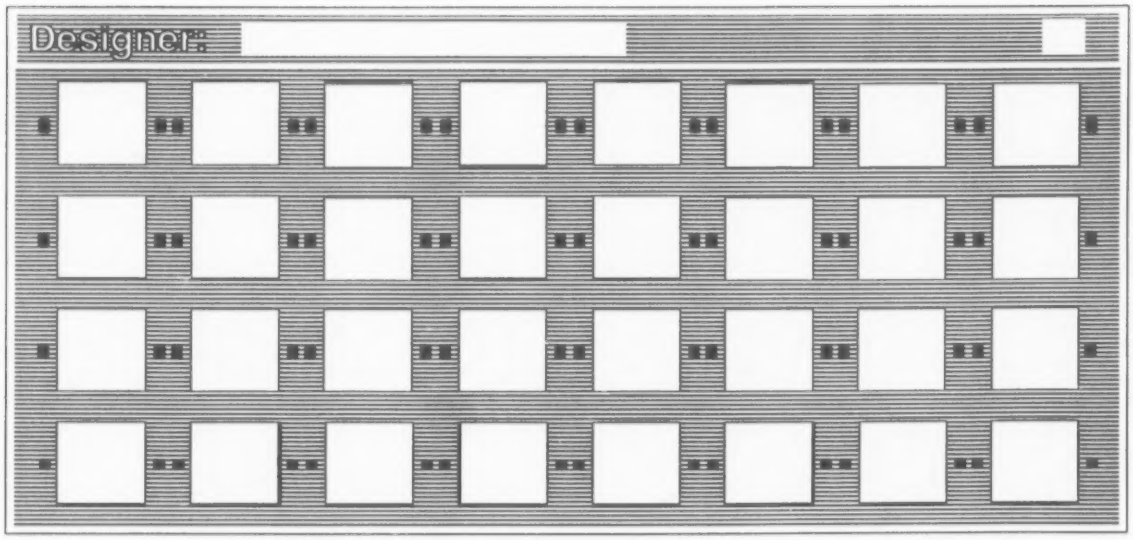


Cut along dotted lines and fold along solid lines.

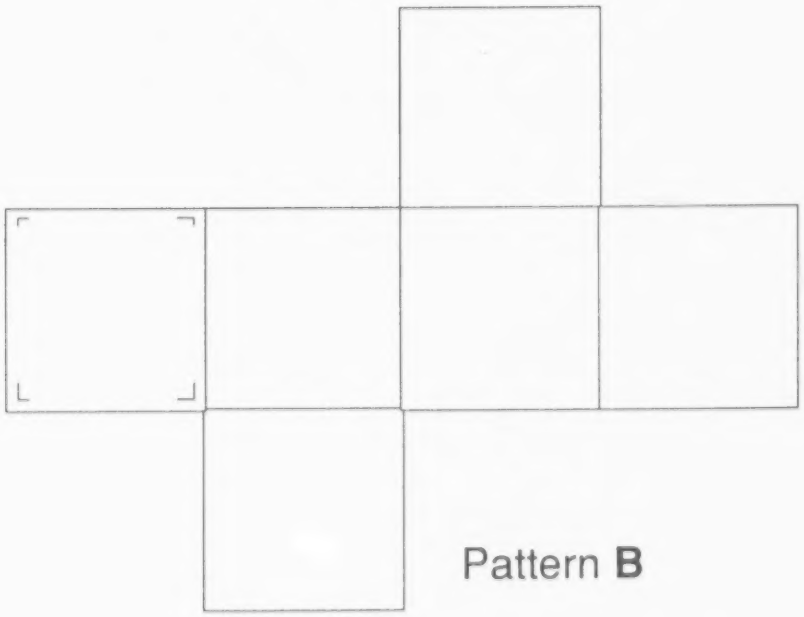
Assemble with glue and/or transparent tape.

Design Table 1

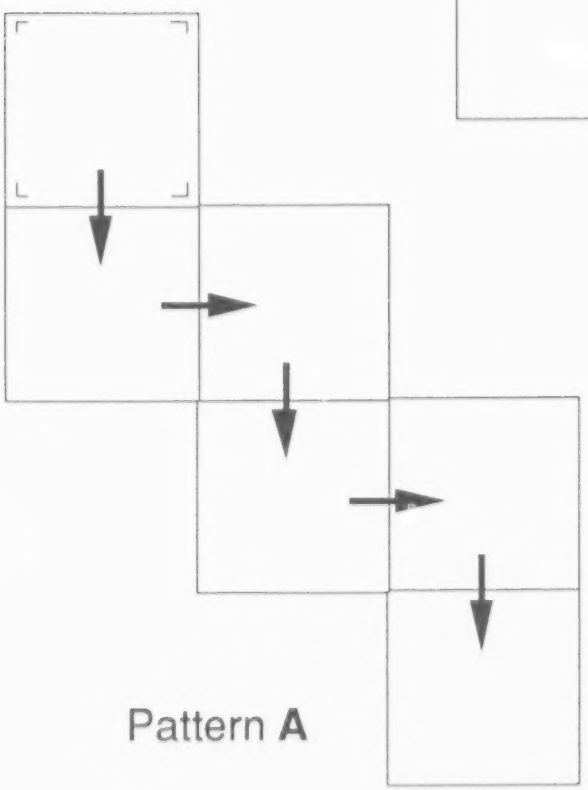




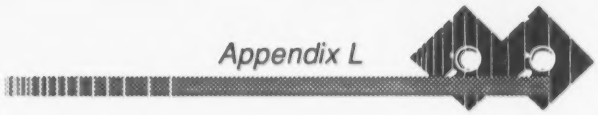
Design Table 2



Pattern **B**



Pattern **A**



OTHER RESOURCES*

Computers and the Elementary Mathematics Curriculum. Edmonton Public Schools, (Revised 1990). Provides a correlation between the objectives of the *Elementary Mathematics Curriculum Guide* (1982) and current approved software for grades 1 to 6.

Computers and the Junior High Mathematics Curriculum. Edmonton Public Schools, 1990. Provides a correlation between the objectives of the *Junior High Mathematics Teacher Resource Manual* (1988) and current approved software for grades 7 to 9.

Both of the above publications are available from:
Edmonton Public Schools
Distribution Centre
18004 - 116 Avenue
Edmonton, Alberta
T5L 1L5
453-8000

Computer-Integrated Instruction Inservice Notebook: Secondary School Mathematics. ICCE, 1988. Provides material for designing and implementing inservice programs for teachers. Section 4 has specific lesson plans for mathematics for all levels.

Available from:
ISTE Publications
1787 Agate Street
Eugene, Oregon
97403
(503) 346-4414
Cost: US$40 (1989)

Computers in Mathematics Education, 1984 Yearbook. Edited by V.P. Hansen, et al. Reston, VA: National Council of Teachers of Mathematics, 1984. ISBN: 0-87353-210-4. (Teacher). Discusses computing from standpoints of its challenge, impact and perspective as a diagnostic tool. Discusses programming as a means of teaching mathematics.

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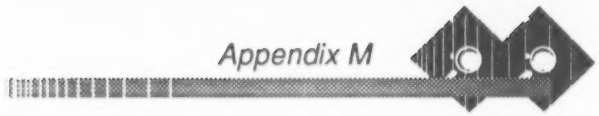
* The titles of the student learning resources identified were provided through the courtesy of Edmonton Public School Board. This is not to be construed as an explicit or implicit departmental approval for use. These titles are provided as a service only to assist local jurisdictions to identify resources that contain potentially useful ideal for teachers. The responsibility to evaluate these resources prior to selection rest with the local jurisdiction according to local policy.

Computing and Mathematics: The Impact on Secondary School Curricula. Edited by J.T. Fey. Reston, VA: National Council of Teachers of Mathematics, 1984. ISBN: 0-87353-212-0 (Teacher). Report of a major conference. Topics include mathematics and the new information technology, impact of computing on algebra, geopmetry, calculus and discrete mathematics and algorithmic methods, and prospects and strategies for change in school mathematics.

Both of the above publications are available from:
National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia



SOFTWARE DISTRIBUTORS

ACCESS NETWORK*
256 Midpark Way SE
Calgary, Alberta
T2X 2A8
(403) 256-1000 ext. 376

Conduit
University of Iowa
Oakdale Campus
Iowa City, Indiana
52242
(319) 355-4100

Davidson & Associates
3135 Kashiwa Street
Torrance, California
98505
(213) 534-4070

EduSoft
P.O. Box 2560
Berkeley, California
94702
(415) 548-2304

Grolier Educational Associates
20 Torbay Road
Markham, Ontario
L3R 1G6
(416) 474-0333

Holt, Rinehart & Winston of Canada Ltd.
55 Horner Avenue
Toronto, Ontario
M8Z 4X6
(800) 268-2132

Houghton Mifflin Canada Ltd.
150 Steelcase Road West
Markham, Ontario
L3R 1B2

ISTE (formally ICCE)
1787 Agate Street
Eugene, Oregon
97403-9905
(503) 346-4414

Josten Learning Systems
6170 Cornerstone Court East
San Diego, California
92121-3710
(619) 587-0087

Learning Company, The
6493 Kaiser Drive
Freemont, California
94555
(415) 792-2101

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* MECC - Jurisdictions who have MECC Associate Membership (check with your principal or local board) may order from either ACCESS NETWORK or MECC.

Learning Resources Distributing Centre
12360 - 142 Street
Edmonton, Alberta
T5L 4X9
(403) 427-2767

MECC*
#410 - 3771 Jacobs Road
Richmond, British Columbia
V6V 2A2
(800) 663-9772
Fax: (604) 276-2831

Merlan Scientific Ltd.
247 Armstrong Avenue
Georgetown, Ontario
L7G 3N4
(800) 387-2474

Milliken Publishing Company
c/o Britannica Learning Materials
P.O. Box 2249
175 Holiday Inn Drive
Cambridge, Ontario
N3C 3N4
(519) 658-4621

Mindscape Inc.
3444 Dundee Road
Northbrook, Illinois
60062
(312) 480-7667

Nelson Canada Ltd.
1120 Birchmount Road
Scarborough, Ontario
M1K 5G4
(416) 752-9100

School Services of Canada
66 Portland Street
Toronto, Ontario
M5V 2M8
(416) 366-0903

Springboard Software
7808 Creekridge Circle
Minneapolis, Minnesota
55435
(612) 944-3912

Sunburst Communications
P.O. Box 3240
Station F
Scarborough, Ontario
M1W 9Z9
(800) 247-6756

SVE
134 Diversey Parkway
Chicago, Illinois
60614-1299
(312) 525-1500

WINGS for learning
Box 660002
Scotts Valley, California
95067
(800) 321-7511